

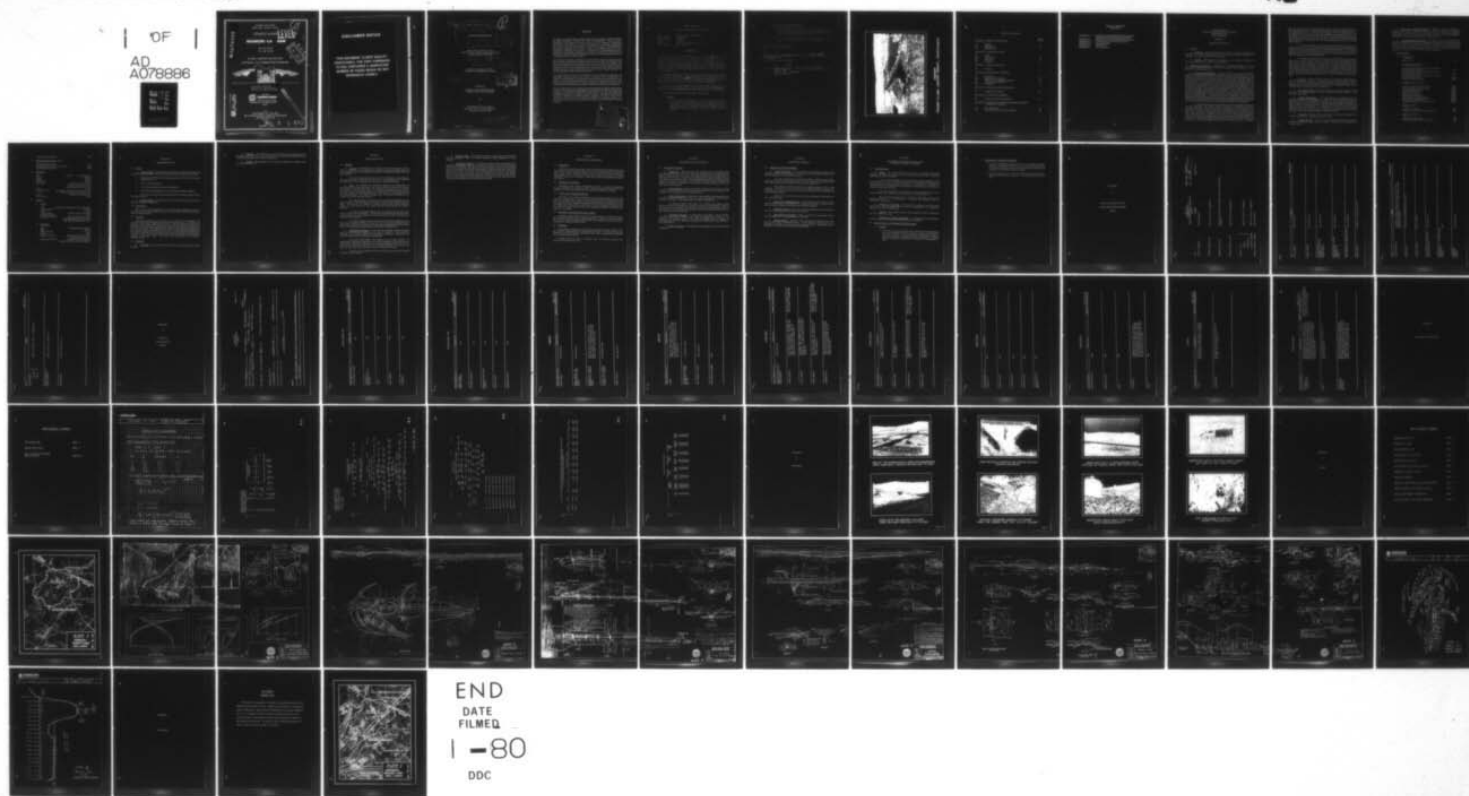
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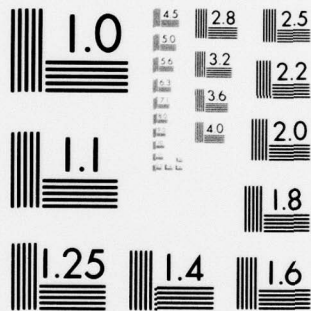
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NATIONAL DAM INSPECTION PROGRAM. SHANGRI-LA DAM (NDI-PA-00248, --ETC(U)
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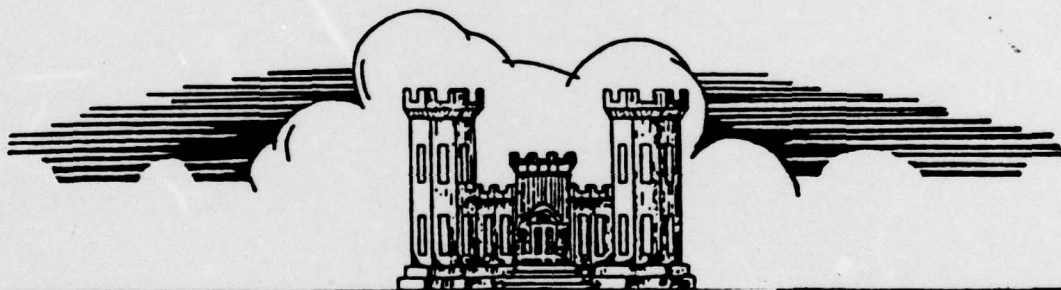
DELAWARE RIVER BASIN
BROAD RUN, CHESTER COUNTY

PENNSYLVANIA **LEVEL**
SHANGRI-LA DAM

NDI-PA 00248

PA DER 15-295

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Prepared By



O'BRIEN & GERE

Justin & Courtney Division
PHILADELPHIA, PENNSYLVANIA
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FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND

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Shangri-La Dam (NDI-PA-00248,
PA DER-15-295)

DELAWARE RIVER BASIN, Broad Run,
Chester County, Pennsylvania.
Phase I Inspection Report,

Name of Dam: Shangri-La Dam
County & State: Chester County, Pennsylvania
Inventory Number: PA00248

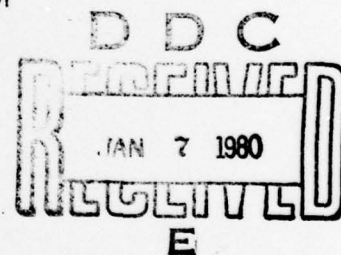
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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

15 DACW31-79-C-0010



Prepared by:

O'BRIEN & GERE ENGINEERS, INC
JUSTIN & COURTNEY DIVISION

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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JOB

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Shangri-La Dam ID #PA00248
State Located: Pennsylvania
County Located: Chester
Stream: Broad Run
Coordinates: Latitude $39^{\circ} 47.0'$, Longitude $75^{\circ} 44.4'$
Date of Inspection: (June 12, 1979),

ASSESSMENT

Shangri-La Dam is a homogeneous, impervious, earth embankment with a downstream layer of random fill. The dam is approximately 800 feet long with a maximum height of 32 feet and is provided with a vertical sand drain in the downstream section. The level of the reservoir is controlled by means of a rectangular, reinforced concrete, drop inlet spillway (service spillway) located near the right abutment (looking downstream). A 150-foot wide, grass covered spillway (emergency spillway) provides additional discharge capacity and is also located in the right abutment area. The dam was constructed to impound a reservoir for recreational purposes.

Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway system (service and emergency spillway) is capable of passing the entire Probable Maximum Flood (PMF) without the dam being overtopped. The selected Spillway Design Flood (SDF) for this "Small" size, "High" hazard structure is the PMF. Therefore, the spillway system is classified as "Adequate".

Based on visual observations, discussions with the Owner's representative, and review of the information obtained from the Pennsylvania Department of Environmental Resources (DER), Shangri-La Dam appears to be in good condition.

Recommendations and Remedial Measures are as follows:

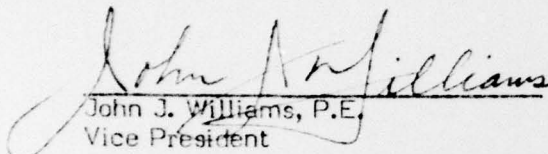
a. Facilities.

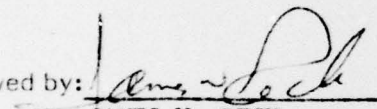
1. The trees, brush, and weeds that have overgrown the embankment and downstream area should be removed to permit more detailed inspection of the dam. If any distress such as sloughing, cracking or seepage is observed, the condition should be evaluated by a licensed professional engineer experienced in the design and construction of dams.

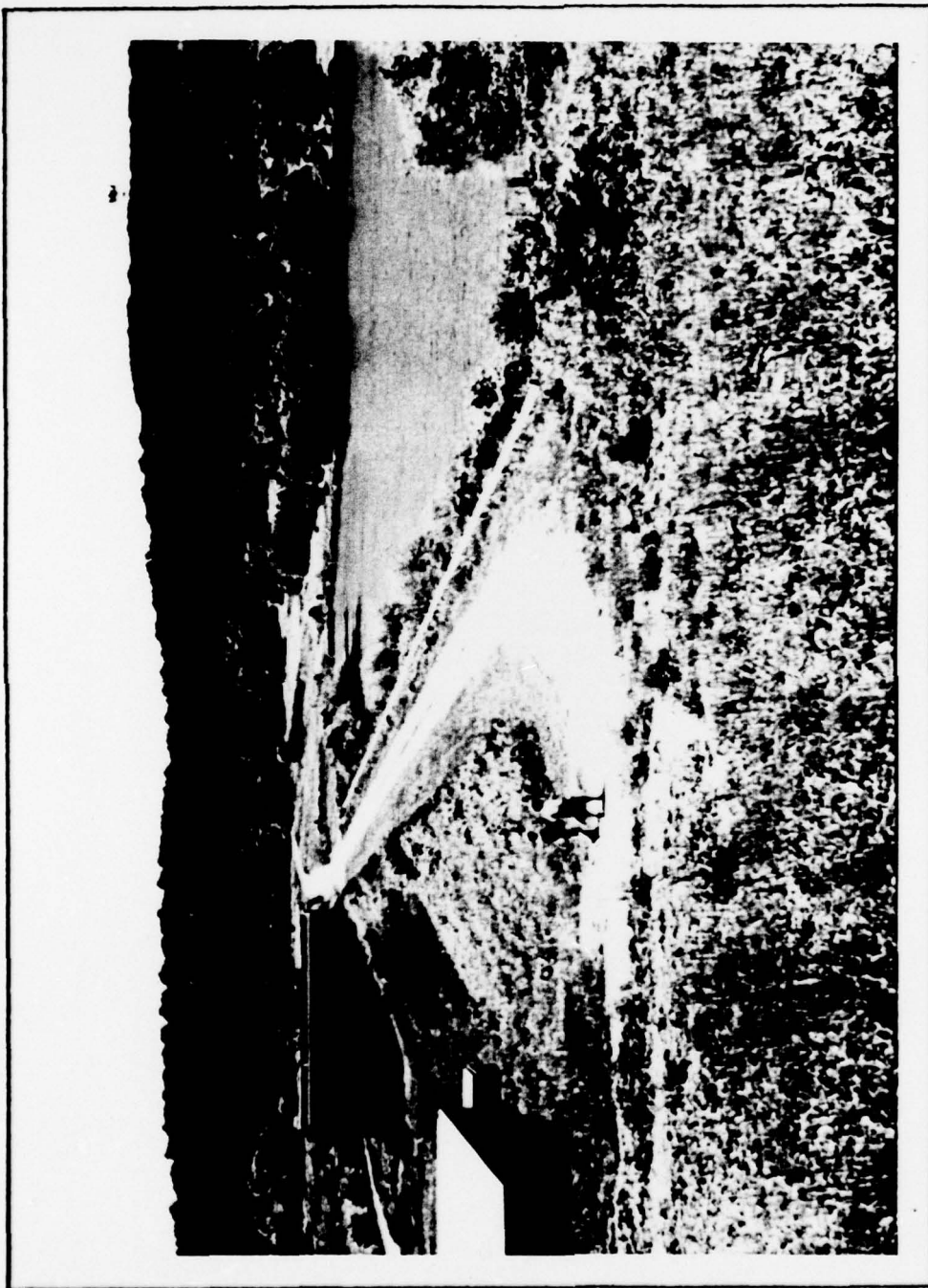
b. Operation and Maintenance Procedures.

1. A regular maintenance program should be developed and implemented. This program should include, but not be limited to, cutting of the brush and weeds on a regular basis and periodic inspection and operation of the reservoir drain sluice gates.
2. A formal warning system should be established within the downstream building to notify occupants of any impending peril to the dam.

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION

 Date: 5 Sept. 1979
John J. Williams, P.E.
Vice President
Pennsylvania Registration PE006920E

Approved by:  Date: 19 Sep 1979
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



*OVERVIEW
SHANGRI LA DAM, CHESTER COUNTY, PENNSYLVANIA*

TABLE OF CONTENTS

	<u>PAGE</u>
SECTION 1 - PROJECT INFORMATION	
1.1 General	1
1.2 Description	1
1.3 Pertinent Data	3
SECTION 2 - ENGINEERING DATA	
2.1 Design	5
2.2 Construction	5
2.3 Operation	5
2.4 Evaluation	5
SECTION 3 - VISUAL INSPECTION	
3.1 Findings	7
SECTION 4 - OPERATIONAL FEATURES	
4.1 Procedures	9
4.2 Maintenance of the Dam	9
4.3 Maintenance of Operating Facilities	9
4.4 Warning System in Effect	9
4.5 Evaluation	9
SECTION 5 - HYDRAULICS AND HYDROLOGY	
5.1 Evaluation of Features	10
SECTION 6 - STRUCTURAL STABILITY	
6.1 Evaluation of Structural Stability	11
SECTION 7 - ASSESSMENT, RECOMMENDATIONS, PROPOSED REMEDIAL MEASURES	
7.1 Dam Assessment	12
7.2 Recommendations, Remedial Measures	12

TABLE OF CONTENTS
(Continued)

APPENDIX A -	CHECKLIST, ENGINEERING DATA, DESIGN CONSTRUCTION, OPERATION, PHASE I
APPENDIX B -	CHECKLIST, VISUAL INSPECTION, PHASE I
APPENDIX C -	HYDROLOGIC & HYDRAULIC DATA
APPENDIX D -	PHOTOGRAPHS
APPENDIX E -	DRAWINGS
APPENDIX F -	SITE GEOLOGY

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
SHANGRI-LA DAM
NDI ID #PA00248

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if Shangri-La Dam constitutes a hazard to human life or property.

1.2 Description of Project (Based upon information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania)

a. Dam and Appurtenances. Shangri-La Dam is an earth embankment approximately 800 feet in length with a maximum height of about 32 feet. The dam impounds a reservoir with a surface area of 25.5 acres and a storage capacity of 208 acre-feet at normal pool. The crest of the dam is 25 feet wide. The side slopes are 2.5 horizontal to 1 vertical (2.5H:1V) from the dam crest (Elevation 272.0) to Elevation 262.0. At this elevation the upstream slope continues at 3.5H:1V and the downstream slopes grades to the toe at 3H:1V (see Plate 5 in Appendix E). The embankment is composed of a homogeneous impervious fill with a downstream shell of random backfill. The upstream slope is protected by a 12-inch thick layer of dumped riprap placed on a 6-inch thick sand blanket. A key trench of impervious material, symmetrical about the dam axis, extends a maximum of 10 feet below the base of the embankment. The key trench has a maximum bottom width of 11 feet and side slopes of 1H:1V. An 18-inch thick vertical sand drain is located 27 feet downstream of the dam axis and extends a distance of 660 feet between abutments. The drain contains a 6-inch diameter perforated corrugated metal pipe (CMP) which drains into a CMP outlet buried in a horizontal filter blanket in the streambed.

A service spillway and an emergency spillway are provided in the area of the right abutment. The service spillway consists of a rectangular, reinforced concrete, drop inlet structure (see Plate 7 in Appendix E). The upstream crest length at Elev. 265.9 is 25.3 feet long and the combined length of the side weirs at Elev. 266.0 is 56 feet. The interior walls of the inlet structure have a slope of 1H:1V and drop from the spillway crest to Elev. 256.6. The concrete trapezoidal section is maintained at a 2 percent slope for a distance of 56 feet downstream. At this point the spillway discharge channel descends on a slope of 1H:1V and directs discharge into a concrete stilling basin with a floor elevation of 247.0. The stilling

basin contains chute blocks, baffles, and an end sill. The entire concrete section of the discharge channel is provided with a sand and perforated pipe underdrain system. The trapezoidal section is maintained downstream of the stilling basin and is riprapped for about 110 feet. At this point the discharge channel turns to the left and follows the stream valley side slope where three riprapped drop structures containing concrete overflow weirs have been constructed at 100-foot intervals. Approximately 450 feet beyond the turn, the discharge channel joins the original stream channel.

The emergency spillway is a trapezoidal earth channel also located in the right abutment area. The service spillway is located within the emergency spillway channel and both spillways lead into the same discharge channel. The emergency spillway channel is 150 feet wide with side slopes of 2H:1V on the cut near the embankment and 3H:1V on the abutment slope. The channel extends approximately 200 feet upstream and 350 feet downstream.

The outlet works consist of an 18-inch diameter reinforced concrete pipe placed on a concrete cradle. The pipe is provided with reinforced concrete anti-seep collars at 24-foot intervals and discharges flow into a reinforced concrete impact basin energy dissipator. The outlet pipe is provided with an upper and a lower intake structure (see Plate 4 in Appendix E). A vertical 6-inch diameter steel pipe, equipped with an 8-inch diameter sluice gate at Elevation 250.0, is connected to the outlet pipe approximately 20 feet from the upstream toe to form the upper intake. The lower intake consists of a 24-inch diameter flap gate on the upstream end of the 18-inch diameter outlet pipe with an invert elevation of approximately 242.

b. Location. Shangri-La Dam is located on Broad Run, approximately 4 miles southeast of Avondale, PA. The dam lies within Garden Township in Chester County. The dam site is shown on the USGS Quadrangle entitled "Kennett Square, Pennsylvania" at coordinates N 39° 47.0', W 75° 44.4'. A regional location plan of Shangri-La Dam is enclosed as Plate 1, Appendix E.

c. Size Classification. Based on the maximum storage capacity of 398 acre-feet and maximum height of 32 feet, Shangri-La Dam is classified in the "Small" size category.

d. Hazard Classification. A 3-story structure is constructed into the downstream portion of the embankment. The third floor of the building may be entered from the crest of the dam. Although it is not currently occupied on a regular basis, community activities are occasionally held within the building and daily occupancy is scheduled for the future. Another structure which is only partially completed is located at the downstream toe near the left abutment. Therefore, a dam failure could result in loss of lives and extensive property damage. Shangri-La Dam is therefore considered a "High" hazard dam.

e. Ownership. Shangri-La Dam is owned by Mrs. Eleanor Reynolds, Green Valley Farms, R.D. #1, Avondale, Pennsylvania 19311.

f. Purpose of Dam. The dam was originally constructed to impound a reservoir for recreation and irrigation purposes. Presently, the reservoir serves neither purpose.

g. Design and Construction History. Shangri-La Dam was designed by Gideon Yachin of GEO - Technical Services, Consulting Engineers & Geologists, Harrisburg, PA. Construction of the dam began in July of 1966 and was completed in October of 1969. The construction work was carried out by Dominic DiFilippo of Green Valley Farms under the supervision of Gideon Yachin.

h. Normal Operating Procedures. The reservoir surface is normally maintained at Elevation 266.0 (the service spillway crest elevation for the side weirs). According to the design drawings, withdrawal and releases from the reservoir would be done through the upper intake by operating the 8-inch diameter slide gate. Complete reservoir drawdown within 72 hours can be accomplished through the lower intake by operation of the 24-inch diameter flap gate.

1.3 Pertinent Data

a. Drainage Area.

Square Miles	1.3
--------------	-----

b. Discharge at Dam Site. (cfs)

Service Spillway (reservoir surface at emergency spillway crest, Elev. 267.6)	500
Service Spillway Capacity (reservoir surface at top of dam, Elev. 272.0)	1,650
Emergency Spillway Capacity (reservoir surface at top of dam Elev. 272.0)	3,750
Combined Spillway Capacity	5,400

c. Elevation. (feet above MSL)

Service Spillway Crest (front wall)	265.9
Service Spillway Crest (side walls)	266.0
Emergency Spillway Crest	267.6
Top of Dam (Design)	272.0
Top of Dam (low point)	271.96
Outlet Works Upper Intake	250.0+
Outlet Works Lower Intake Invert	242.0+
Outlet Pipe Invert (outlet end)	240.5+
Streambed Elevation at Downstream Toe	240.0+

d. Reservoir. (miles)

Length of Normal Pool	0.44
Length of Maximum Non-Overtopping Pool	0.51

e. Storage. (acre-feet)

Normal Pool, Elev. 266.0	208
Emergency Spillway Crest, Elev. 267.6	248

	Top of Dam, Elev. 272.0	398
f.	<u>Reservoir Surface Area. (acres)</u>	
	Normal Pool, Elev. 266.0	25.5
	Emergency Spillway Crest, Elev. 267.6	28.5
	Top of Dam, Elev. 272.0	41.0
g.	<u>Dam Data.</u>	
	Type	Compact Earth Embankment
	Length	800 feet
	Height	32 feet
	Crest Width	25 feet
	Side Slopes	2.5H:1V above Elev. 262.0; 3.5H:1V upstream and 3H:1V downstream below Elev. 262.0
	Zoning	None
	Impervious Core	Homogeneous, impervious embankment with thin downstream shell of random fill.
	Cutoff	Impervious Cutoff Trench
	Grout Curtain	None
h.	<u>Spillways.</u>	
	1) <u>Service</u>	
	Type	Rectangular, reinforced concrete drop inlet.
	Length of Weir	81.3 feet
	Gates	None
	Crest Elevation	Upstream 265.9; Sides 266.0
	Upstream Channel	None
	Downstream Channel	450-foot long channel with 3 riprapped drop structures at 100- foot intervals (See Section 1.2.a).
	2) <u>Emergency</u>	
	Type	Trapezoidal Earth Channel
	Width	150 feet
	Crest Elevation	267.6
	Gates	None
	Upstream Channel	200-foot long curved channel graded into the reservoir.
	Downstream Channel	350-foot long curved channel graded toward the original streambed.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The information available in the DER main office files in Harrisburg, Pennsylvania, for review of Shangri-La Dam includes the following:

1. "Application", "Report Upon the Application", and "Permit" to construct Shangri-La Dam.
2. Set of 12 design drawings.
3. Construction progress reports and photographs.
4. Miscellaneous correspondence, memoranda, and inspection reports.

Piezometric records were also obtained from Mr. Gideon Yachin of GEO-Technical Services.

b. Design Features. The design features are described in Section 1.2.a and shown on the plates in Appendix E.

2.2 Construction

Based on the field investigation and the information available in the construction reports, the dam appears to have been constructed in general conformance with the design drawings.

2.3 Operation

Operational procedures are limited to the control of the upstream and downstream gates which regulate flow through the outlet works. A hand wheel for operation of the upper intake slide gate and a chain for operation of the lower intake flap gate are located at the top of the upstream face and are accessible from the crest of the dam. Two additional sluice gates are provided at the downstream toe where the outlet pipe branches into two pipes. One gate controls discharge into the impact basin from the 18-inch diameter reservoir drain pipe and the other gate controls flow from the 10-inch diameter pipe which terminates in a concrete box adjacent to the impact basin. The 10-inch pipe was provided for a proposed irrigation system.

2.4 Evaluation

a. Availability. The engineering data utilized in this report were provided by DER.

b. Adequacy. The information provided by DER, visual observations and discussions with Mrs. Jackie Powell, Secretary to Mrs. Eleanor Reynolds, the Owner, is considered adequate for a Phase I investigation.

c. Validity. There appears to be no reason to question the validity of the data obtained from DER.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Shangri-La Dam took place on June 12, 1979. At the time of the inspection, the reservoir surface was slightly above the service spillway crest (front wall), Elevation 265.9. No underwater areas of the dam were inspected.

The observations and comments of the field inspection team appear in the checklist which is Appendix B of this report. The appearance of the facility indicates that the dam and its appurtenances are marginally maintained.

b. Dam. The upstream and downstream slopes of the embankment are covered with thick weeds and brush which make it difficult to assess the condition of the slopes. Several small areas which supported no vegetation were observed near the top of the downstream slope in the general vicinity of the outlet works. The upper portion of the downstream slope in this vicinity is considerably steeper than the remainder of the slope indicating that some surface sloughing of the random fill material may have occurred.

The visible portion of the riprap on the upstream slope appears to be in good condition. Concrete slabs are interspersed with the riprap along the upstream slope. According to Mr. Yachin, the design engineer, the concrete segments perform the same function as the riprap and were placed purely for aesthetic purposes.

A 3-story, brick-faced building has been constructed into the downstream portion of the embankment. The building is situated so that the third floor may be entered from the downstream edge of the crest of the dam. The purpose of this structure is unknown.

The design drawings indicate that the knoll located immediately to the left of the emergency spillway was to be cut to the top of dam design elevation (Elev. 272.0). However, the survey of the dam crest revealed that the knoll ranges from 8 to 10 inches above design elevation (see Plate 9 in Appendix E).

c. Appurtenant Structures. The service and emergency spillways appeared to be in good operating condition on the date of inspection. The three drop structures in the service spillway discharge channel could not be inspected due to the thick growth of brush and weeds in the channel.

The outlet works impact basin appears to be in good condition. A trapezoidal, riprap-lined stilling basin is located immediately downstream of the impact basin. During the inspection, water was discharging into the basin from a 6-inch diameter galvanized steel pipe which provides drainage in the area of the building. The entire outlet area was overgrown with weeds and brush.

At the time of the inspection, the chain which operates the lower intake flap gate was not observed.

d. Reservoir Area. The reservoir side slopes average about 10 percent and are well vegetated. There is no visible evidence of slope instability or excess siltation.

e. Downstream Channel. The spillway discharge channel and outlet works channel were overgrown with weeds and brush and could not be properly inspected. According to the design drawings, the discharge channel merges with the natural stream at a stilling basin located approximately 200 feet downstream of the outlet works impact basin. There are no inhabitable structures along the downstream channel in the area that would be subject to flooding in the event of a dam failure. However, the two bottom floors of the 3-story structure located in the downstream portion of the embankment would be flooded in the event of a dam failure and many lives could be endangered if the building were occupied.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

The 8-inch diameter slide gate with an invert elevation of 250.0 on the upper intake and the 24-inch diameter flap gate with an invert elevation of 242.0 on the lower intake provide upstream control of the outlet pipe for reservoir drawdown. Sluice gates on the 10-inch and 18-inch pipes at the downstream toe provide additional control of the outlet pipe. There are no other known operational features for the dam.

4.2 Maintenance of the Dam

According to the Owner's representative, there is no regular maintenance program established for Shangri-La Dam. Periodic inspections are performed by employees of Green Valley Farms and maintenance is performed as needed.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, the operating gates are not maintained on a regular basis. At the time of inspection, the concrete structure upon which the upstream gate controls are located was overgrown with bushes and was not readily accessible. During the inspection, the hand wheel for operation of the 8-inch sluice gate was provided by Mrs. Powell. However, an adapter is required to fit the wheel to the gate stem; therefore, the operating condition of the sluice gate could not be assessed.

4.4 Description of any Warning Systems in Effect

According to Mrs. Powell, there is no formal system of warning the downstream building occupants of an impending dam failure. However, the water level in the reservoir could be readily monitored from the building since the third floor overlooks the crest of the embankment.

4.5 Evaluation

The overgrown vegetation on the embankment slopes and in the vicinity of the dam indicates a general lack of maintenance at the site. A regular inspection and maintenance program should be established which would include periodic operation of the drawdown control gates.

It appears that the dam is accessible under all weather conditions for inspection and emergency action.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Shangri-La Dam has a drainage area of 1.3 square miles and impounds a reservoir with a normal pool storage capacity of 208 acre-feet. Ground elevations range from 442 in the upper reaches of the drainage basin to 265.9 at the normal pool. The slopes of the drainage basin adjacent to the reservoir vary between 2 and 20 percent. The drainage basin is about 25 percent wooded while the remainder of the basin is divided about equally between cropland and pasture. The runoff characteristics of the basin may undergo change in the future as a result of development.

b. Experience Data. There are no known reservoir level records or rainfall records kept for this dam. Records of piezometers located along the length of the embankment were obtained from Mr. Gideon Yachin.

c. Visual Observations. On the date of the inspection, there appeared to be no adverse conditions that would restrict the proper functioning of the hydraulic features of the dam. Further observations are given in Appendix B.

The Spillway Design Flood (SDF) for a "Small" size, "High" hazard structure is given as a range from one-half of the PMF to the full PMF. Based on the location of the building in the downstream portion of the embankment and the high probability of loss of life if the building were occupied during a dam failure, the SDF was chosen to be the full PMF.

d. Overtopping Potential. The peak inflow and outflow rates for the SDF were determined to be 4,238 cfs and 4,028 cfs, respectively. Based on the hydrologic and hydraulic analyses, the combined spillway system is capable of discharging the full PMF without overtopping of the embankment (see Appendix C for computations).

e. Spillway Adequacy. The Shangri-La Dam spillway system is classified as "Adequate".

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The steep slope in the uppermost portion of the downstream face and the bare spots immediately below are possible indications of surface sloughing in the random fill material.

The thick overgrowth of vegetation prohibits a detailed visual examination of the surface of the embankment. The root systems of the larger bushes could also create potential seepage paths through the embankment.

The structural features of the service spillway appear to be in good condition. On the date of the inspection, the spillway discharge channel was overgrown with weeds so that the three drop structures located in the channel could not be inspected properly.

Based on the restricted visual observations, the embankment appears to be structurally stable.

b. Design and Construction Data. Design drawings, construction progress reports, and construction photographs were obtained from DER. However, there were no design calculations included in the provided information.

c. Operating Records. There are no official operating records maintained for this dam, according to the Owner's representative.

d. Post-Construction Changes. There is no record of any changes made to the dam subsequent to the completion of construction.

e. Seismic Stability. Shangri-La Dam is located in Seismic Zone 1 on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 is generally considered to be safe under any expected Zone 1 earthquake loading conditions if it is stable under static loading conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual inspection and review of available information indicate that Shangri-La Dam is in good condition, however the thick overgrowth prohibits a complete assessment.

Minor surface sloughing of the random fill material appears to have occurred near the top of the downstream slope. This sloughing does not appear to have affected the stability of the embankment in any manner. However, the displaced material and steepened slope could subject the downstream face to further sliding and potential instability.

The thick overgrowth of vegetation on the dam, spillways and outlet channels hinders the assessment of the dam based on surface appearance.

The combined spillway system is capable of discharging the full PMF without overtopping of the embankment. Therefore, the spillway system is classified as "Adequate".

b. Adequacy of Information. The information available from DER, visual observations, and discussions with the Owner's representative are considered adequate for a Phase I investigation.

c. Urgency. The remedial measures recommended in Section 7.2 should be effected as soon as possible.

d. Necessity for Further Investigation. The stability of the embankment should be evaluated subsequent to the removal of the overgrowth.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities.

1. The trees, brush, and weeds that have overgrown the dam, spillways and outlet channels should be removed to permit more detailed inspection of the dam. If any distress such as sloughing, cracking, or seepage is observed, the condition should be evaluated by a licensed professional engineer experienced in the design and construction of dams.

b. Operation and Maintenance Procedures

1. A regular maintenance program should be developed and implemented. This program should include, but not be limited to, cutting of the brush and weeds on a regular basis and periodic inspection and operation of the reservoir drain sluice gates.
2. A formal warning system should be established within the downstream building to notify occupants of any impending peril to the dam.

APPENDIX

A

Check List Engineering Data
Design, Construction, Operation
Phase I

NAME OF DAM Shangri-La

ID # PA 00248

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

Sheet 1 of 4

ITEM

REMARKS

AS-BUILT DRAWINGS

None available.

REGIONAL VICINITY MAP

Refer to Plate 1, Appendix E.

CONSTRUCTION HISTORY

Detailed construction progress reports were obtained from DER.

TYPICAL SECTIONS OF DAM

Refer to Plate 5, Appendix E.

OUTLETS - PLAN

DETAILS

CONSTRAINTS

DISCHARGE RATINGS

RAINFALL/RESERVOIR RECORDS

Refer to Plate 4, Appendix E.

Refer to Plate 2, Appendix E.

None available.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Reported in progress reports.

ITEM	REMARKS
MONITORING SYSTEMS	Piezometer records during the reservoir filling stage were obtained from Mr. Gideon Yachin of GEO-Technical Services.
MODIFICATIONS	There are no modifications on record.
HIGH POOL RECORDS	None available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None available.

ITEM	REMARKS
<div> <div>SPILLWAY PLAN</div> <div> <div>SECTIONS</div> <div>DETAILS</div> </div> </div>	Refer to Plates 6 and 7 in Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	Refer to Plate 4, Appendix E.
MISCELLANEOUS	Refer to Section 2.1.a

APPENDIX

B

Check List

Visual Inspection

Phase I

Sheet 1 of 11

National

ID # PA 00248

ID # PA 00248

State Pennsylvania

County Chester

Name Dam Chandrajalla

Hazard Category	High
1. Hazardous materials (e.g., chemicals, explosives)	
2. Fire and explosion hazards	
3. Electrical hazards	
4. Mechanical hazards (e.g., moving parts, machinery)	
5. Environmental hazards (e.g., weather, terrain)	
6. Biological hazards (e.g., bacteria, viruses)	
7. Radiation hazards	
8. Noise and vibration hazards	
9. Ergonomic hazards (e.g., repetitive motion, awkward postures)	
10. Safety hazards (e.g., falls, slips, trips)	

Hazard Category	High
-----------------	------

Date/Location	Infection	June 12, 1979	Weather	Clear	Temperature	70° F

Temperature 70° F

Clear

Date(s) of Inspection June 12, 1979 Weather

Pool Elevation at Time of Inspection 266.0 M.S.L. Tailwater at Time of Inspection 240 + M.S.L.

Inspection Personnel:

~~Robert R. Bowers~~

J. J. Williams

Remarks:

Mrs. Jackie Powell, secretary to Mrs. Eleanor Reynolds, the owner, was also present during the inspection.

CONCRETE/MASONRY DAMS

Sheet 2 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

Sheet 3 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

Sheet 4 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Portions of the random fill material near the top of the downstream slope appear to have sloughed, leaving the slope steeper near the crest.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems noted.	
RIPRAP FAILURES	None observed.	

EMBANKMENT

Sheet 5 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

DRAINS

Water was discharging from a 6-inch diameter pipe, which provides drainage in the downstream building area, into the outlet works stilling basin during the inspection.

JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

No problems noted.

ANY NOTICEABLE SEEPAGE

None observed.

STAFF GAGE AND RECORDER

None

OUTLET WORKS

Sheet 6 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	The intake structure was submerged and could not be inspected. The upper and lower intake sluice gates were not operated during the inspection.	Periodic operation of the sluice gate is recommended.
OUTLET STRUCTURE	The impact basin appears to be in good condition. No flow was occurring through either of the outlet pipes during the inspection.	
OUTLET CHANNEL	The outlet channel was overgrown with weeds and brush at the time of the inspection.	Removal of the weeds and brush to permit more detailed inspection is recommended.
EMERGENCY GATE	There are four sluice gates for controlling the flow through the outlet works; two upstream gates and two downstream gates.	

UNGATED SPILLWAY

Sheet 7 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE WEIR	The entire concrete drop inlet section appears to be in good condition.	
APPROACH CHANNEL	The emergency spillway approach channel was submerged.	
DISCHARGE CHANNEL	The discharge channel was overgrown with weeds and brush at the time of the inspection.	Removal of the weeds and brush to permit more detailed inspection is recommended.
BRIDGE AND PIERS	The service bridge and the pier in the spillway channel appear to be in good condition.	

GATED SPILLWAY

Sheet 8 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

Sheet 9 of 11

<u>VISUAL EXAMINATION</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	Piezometer records taken during the reservoir-filling stage were obtained from GEO-Technical Services. Several of the piezometers were destroyed when the building was constructed, but most of them are still in place.	
OTHER	None	

RESERVOIR

Sheet 10 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
------------------------------	---------------------	-----------------------------------

SLOPES

The reservoir slopes appear to average about 10% and are fairly well vegetated.

SEDIMENTATION

No excessive siltation was apparent on the date of the inspection.

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The spillway discharge channel and the outlet channel join at a stilling basin approximately 200 feet downstream of the outlet works impact basin. The natural stream channel continues from that point. The entire downstream area is overgrown with weeds and brush.	The weeds and brush should be removed to permit more detailed inspection of the channel.
SLOPES	The downstream channel continues on a grade of about 1.0%.	
APPROXIMATE NO. OF HOMES AND POPULATION	There are no homes along the downstream channel within the potential damage area. The damage center would be the building in the downstream portion of the dam. The number of occupants in the building is variable and could possibly exceed 100.	

APPENDIX

C

Hydrologic & Hydraulic Data

TABLE OF CONTENTS - APPENDIX C

PMP CALCULATIONS

SHEET 1

SNYDER COEFFICIENTS

SHEET 1

HEC - 1 DAM SAFETY VERSION
COMPUTER OUTPUT

SHEETS 2-6

SHANGRI LA DAM

SHEET 1

BY SM

DATE 4/9/79

JOB NO.

HYDROLOGY CALCULATIONSDRAINAGE AREA (PLANIMETERED ON USGS QUAD SHEET): 1.25 mi.²PMP CALCULATIONS (HMS REPORT 33)

AREA IS IN ZONE 6

∴ 24-hours, 200 Sq. Mile PMP = 23.5 inches

HR	%	RAINFALL	Δ
6	113	26.6"	26.6"
12	123	28.9"	2.3"
24	132	31.0"	2.1"
48	142	33.4"	2.4"

SNYDER COEFFICIENTS (information provided by Balt. COE)
Area 10

$$C_p = 0.60$$

$$C_t = 1.25$$

$$t_p = C_t (L L_{ca})^{0.3}$$

$$L_{ca} = 0.72 \text{ mi.}$$

$$L = 1.46 \text{ mi.}$$

$$t_p = 1.25 (1.46 \times 0.72)^{0.3} = 1.27 \text{ HR}$$

STAGE-STORAGE AND STAGE-DISCHARGE INFORMATION FOR THE HEC-1 PROGRAM IS OBTAINED FROM THE CURVES SHOWN ON PLATE 2 IN APPENDIX E.

● ● ● ●

● ● ● ●

.....
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 25 SEP 78

QW DATE 06/19/79.
 TIME 13.17.52.

NATIONAL DAM INSPECTION PROGRAM
 SHANGRI LA DAM
 PMF HYDROGRAPH

JOB SPECIFICATION									
NQ	NHR	NMIN	IDAY	IMR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	30	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS=	.20	.30	.40	.50	.60	.70	.80	.90	1.00
NPLAN= 1 NRTIO= 4 LRTIO= 1									

.....

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO SHANGRI LA DAM RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGF	IAUTO
INFLOW	0	0	0	0	0	1	0	0

HYDROGRAPH DATA									
INHYD6	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.30	0.00	1.30	0.00	0.000	0	1	0

PRECIP DATA									
SPFE	PMS	R6	R12	R24	R48	R72	R96		
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00		

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA										
LEUPT	STNKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRYL	CNSTL	ALSHX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
 TP= 1.27 CP= .50 NTA= 0

RECESSION DATA
 STRTO= -1.50 ORCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 15 END-OF-PERIOD ORDINATES. LAG= 1.27 HOURS. CP= .60 VOL= 1.00									
84.	274.	376.	311.	208.	140.	94.	63.	42.	28.
19.	13.	8.	6.	4.					

END-OF-PERIOD FLOW													
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
.....													

PA 3

SUM 26.70 24.30 2.40 42763.
 (678.11 617.11 61.11 1210.91)

HYDROGRAPH ROUTING

ROUTING THROUGH SHANGRI LA DAM RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRI	INAME	ISTAGE	IAUTO
OUTFLO	1	0	0	0	0	1	0	0
QLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR	
0.0	0.000	0.00	1	1	0	0	0	
NSTPS	NSTDL	LAG	AMSK	X	TSK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	-266.	-1	
5-1-3E	266.00	267.00	268.00	269.00	270.00	271.00	272.00	
5-1-3E	0.00	260.00	950.00	2100.00	3100.00	4200.00	5400.00	
5-1-3E	0.	6.	31.	86.	208.	398.	673.	
5-1-3E	243.	250.	255.	260.	266.	272.	280.	
5-1-3E	266.0	0.0	0.0	0.0	0.0	0.0	0.0	

TOPEL 272.0
COOD 3.1
EXPD 1.5
DAMWID 800.

PEAK FLOW IS	773. AT TIME	41.50 HOURS
PEAK FLOW IS	1204. AT TIME	41.50 HOURS
PEAK FLOW IS	1614. AT TIME	41.50 HOURS
PEAK FLOW IS	2019. AT TIME	41.50 HOURS
PEAK FLOW IS	2411. AT TIME	41.50 HOURS
PEAK FLOW IS	2808. AT TIME	41.50 HOURS
PEAK FLOW IS	3214. AT TIME	41.50 HOURS
PEAK FLOW IS	3622. AT TIME	41.50 HOURS
PEAK FLOW IS	4028. AT TIME	41.50 HOURS

SK 4

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				.20	.30	.40	.50	.60	.70	.80	.90	1.00
HYDROGRAPH AT	INFLOW	1.30	1	848.	1272.	1695.	2119.	2543.	2967.	3391.	3815.	4238.
		(3.37)	(	( 24.00)	(36.01)	(48.01)	(60.01)	(72.01)	(84.01)	(96.01)	(108.02)	(120.02)
ROUTED TO	OUTFLO	1.30	1	773.	1204.	1614.	2019.	2411.	2808.	3214.	3622.	4028.
		(3.37)	(	( 21.88)	(34.10)	(45.71)	(57.16)	(68.27)	(79.51)	(91.02)	(102.58)	(114.07)

SUMMARY OF DAM SAFETY ANALYSIS

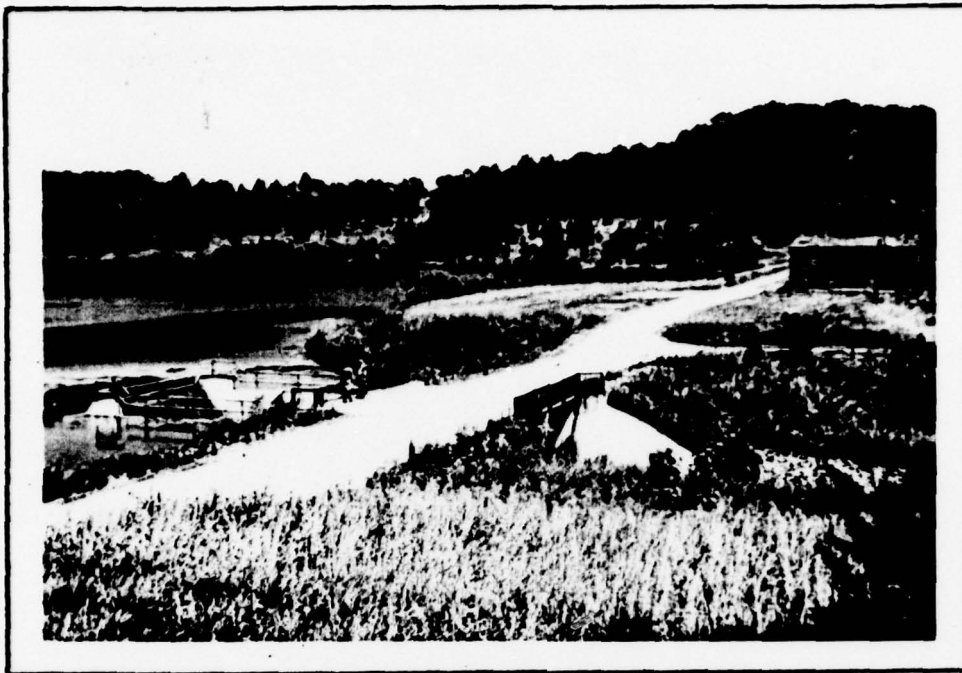
PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 266.00 208. 0.	SPILLWAY CREST 266.00 208. 0.	TOP OF DAM 272.00 398. 5400.	TIME OF MAX OUTFLOW HOURS	DURATION OVER TOP HOURS	MAXIMUM OUTFLOW CFS	MAXIMUM STORAGE AC-FT	MAXIMUM DEPTH OVER DAM	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	TIME OF FAILURE HOURS
					41.50	0.00	773.	263.	0.00	.20	267.74	0.00
					41.50	0.00	1204.	278.	0.00	.30	268.22	0.00
					41.50	0.00	1614.	290.	0.00	.40	268.58	0.00
					41.50	0.00	2019.	301.	0.00	.50	268.93	0.00
					41.50	0.00	2411.	312.	0.00	.60	269.31	0.00
					41.50	0.00	2808.	325.	0.00	.70	269.71	0.00
					41.50	0.00	3214.	338.	0.00	.80	270.10	0.00
					41.50	0.00	3622.	350.	0.00	.90	270.47	0.00
					41.50	0.00	4028.	361.	0.00	1.00	270.84	0.00

SK 6

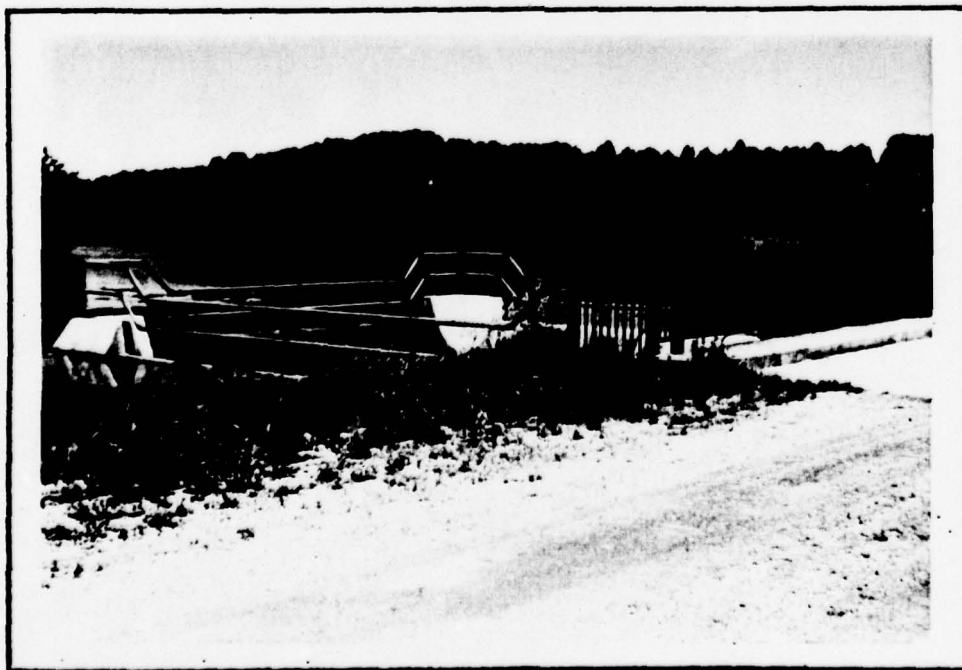
APPENDIX

D

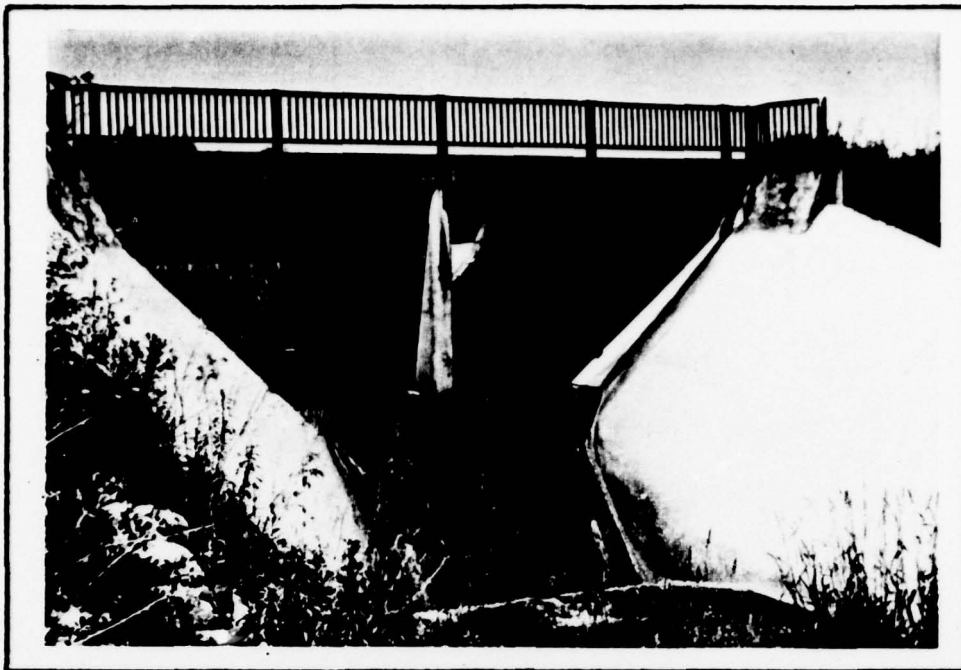
Photographs



*VIEW OF THE EMBANKMENT FROM THE DOWNSTREAM
RIGHT ABUTMENT SHOWING THE SPILLWAY SYSTEM*



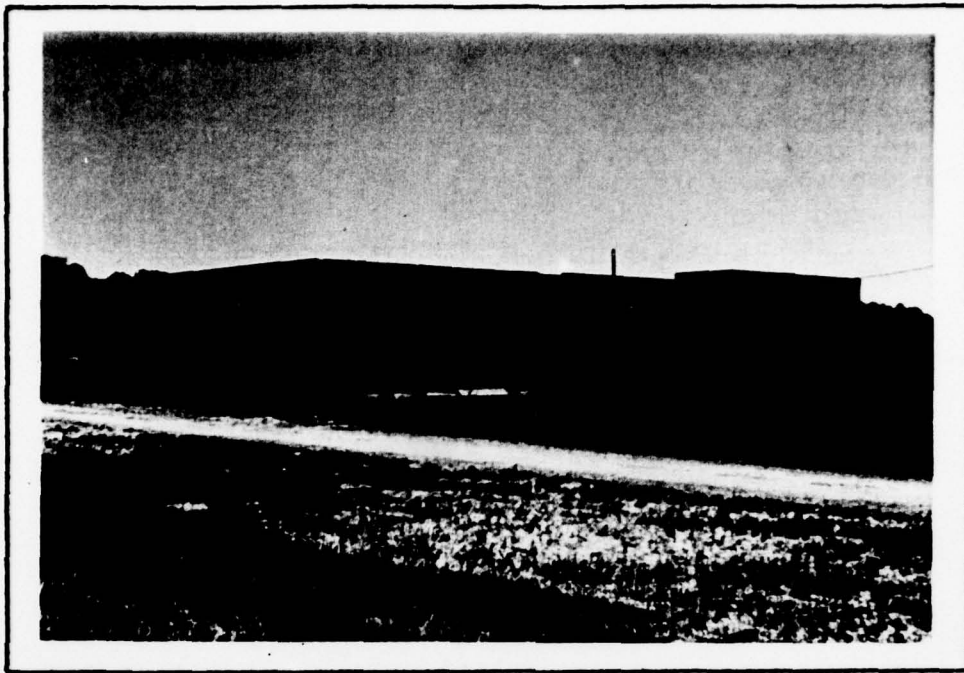
*CLOSE UP OF THE SERVICE SPILLWAY
NEAR THE RIGHT ABUTMENT OF THE DAM*



*DROP SECTIONS THROUGH THE SERVICE SPILLWAY
LOOKING UPSTREAM*



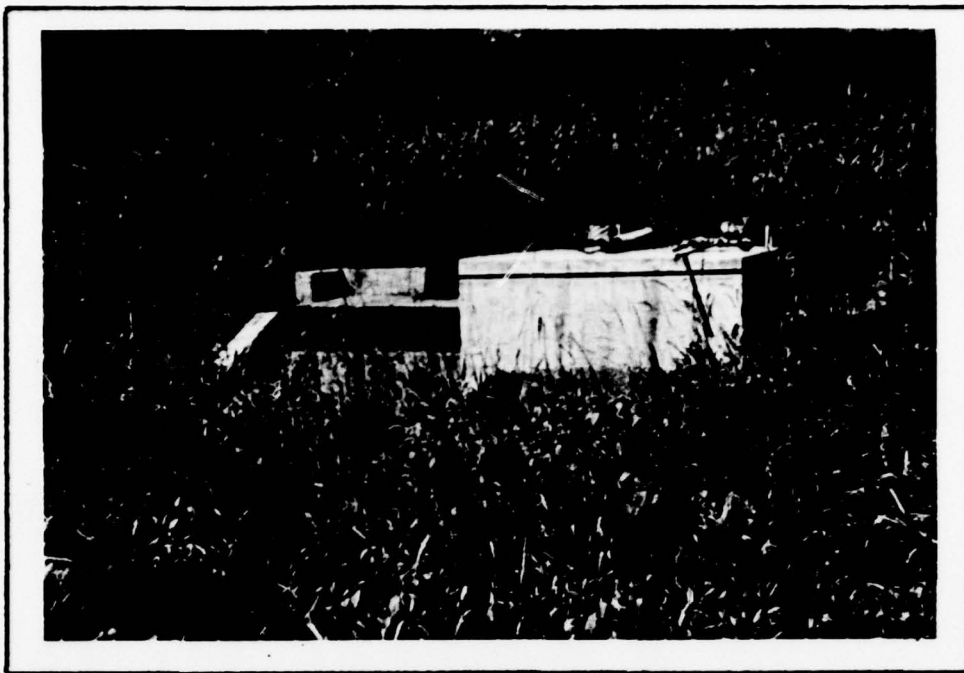
*SPILLWAY DISCHARGE CHANNEL AS VIEWED
FROM THE BRIDGE OVER THE SERVICE SPILLWAY*



*STRUCTURE BUILT IN CONJUNCTION WITH
THE DAM AS VIEWED FROM THE TOP OF THE DAM*



*RESERVOIR DRAIN HOIST STEM AND
HOIST MOUNTING BLOCK*



*RESERVOIR DRAIN SYSTEM IMPACT BASIN
AND BOX OUTLET STRUCTURES*



*PIPE DISCHARGE IN THE OUTLET
WORKS STILLING BASIN*

APPENDIX

E

Drawings

TABLE OF CONTENTS - APPENDIX E

REGIONAL VICINITY MAP	PLATE 1
LOCATION & SITE MAPS	PLATE 2
PLAN OF RESERVOIR AREA	PLATE 2
AREA CAPACITY & RATING CURVES	PLATE 2
GENERAL PLAN & ELEVATION	PLATE 3
OUTLET WORKS, PLAN, SECTIONS & DETAILS	PLATE 4
EMBANKMENT, SECTIONS & DETAILS	PLATE 5
FOUNDATION TREATMENT	PLATE 5
EMERGENCY SPILLWAY PROFILES, SECTIONS & DETAILS	PLATE 6
SERVICE SPILLWAY PLAN, SECTIONS & DETAILS	PLATE 7
PLAN VIEW DAM SHOWING PROBLEM AREAS	PLATE 8
PROFILE OF CREST OF DAM LOOKING DOWNSTREAM	PLATE 9

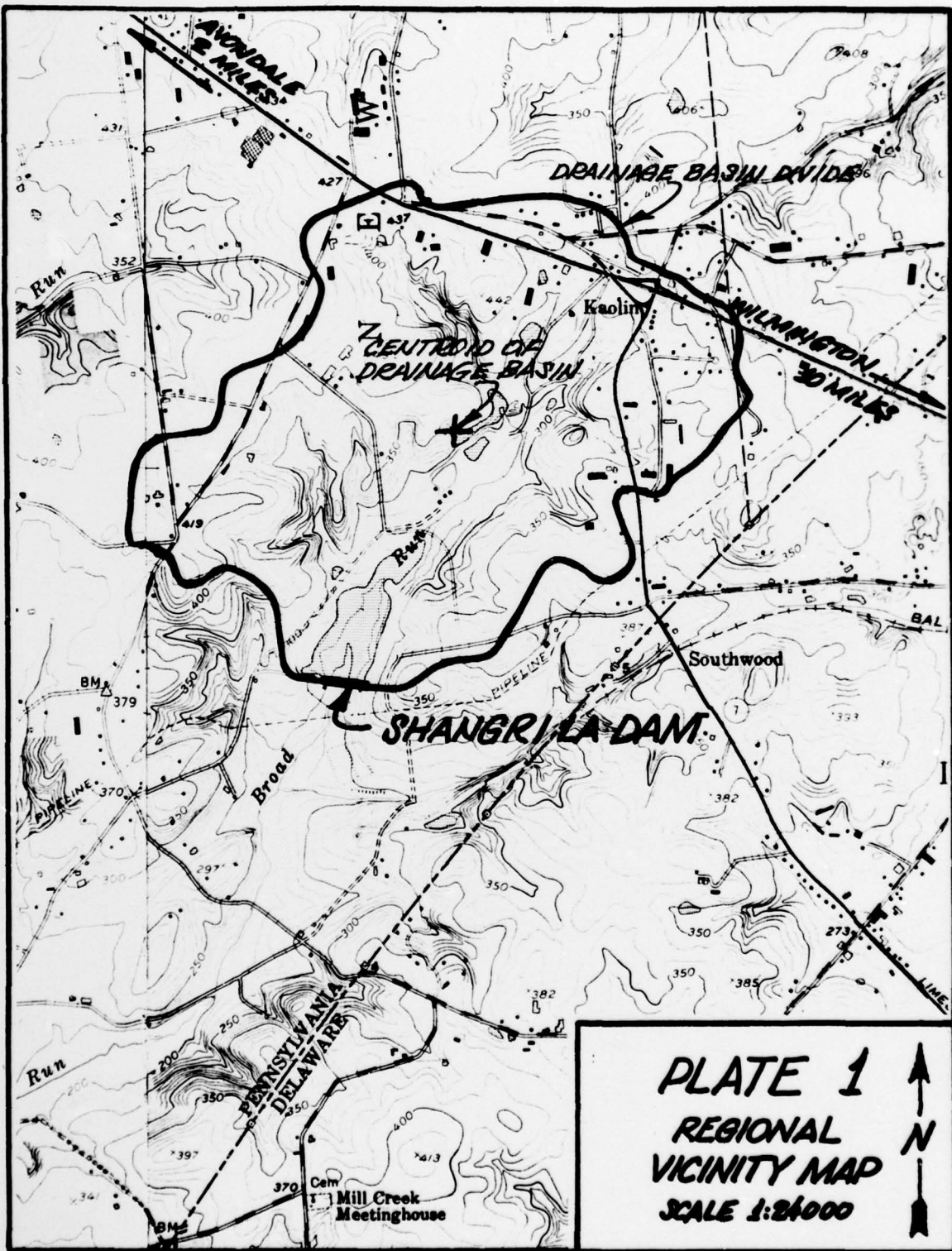
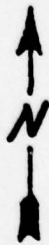
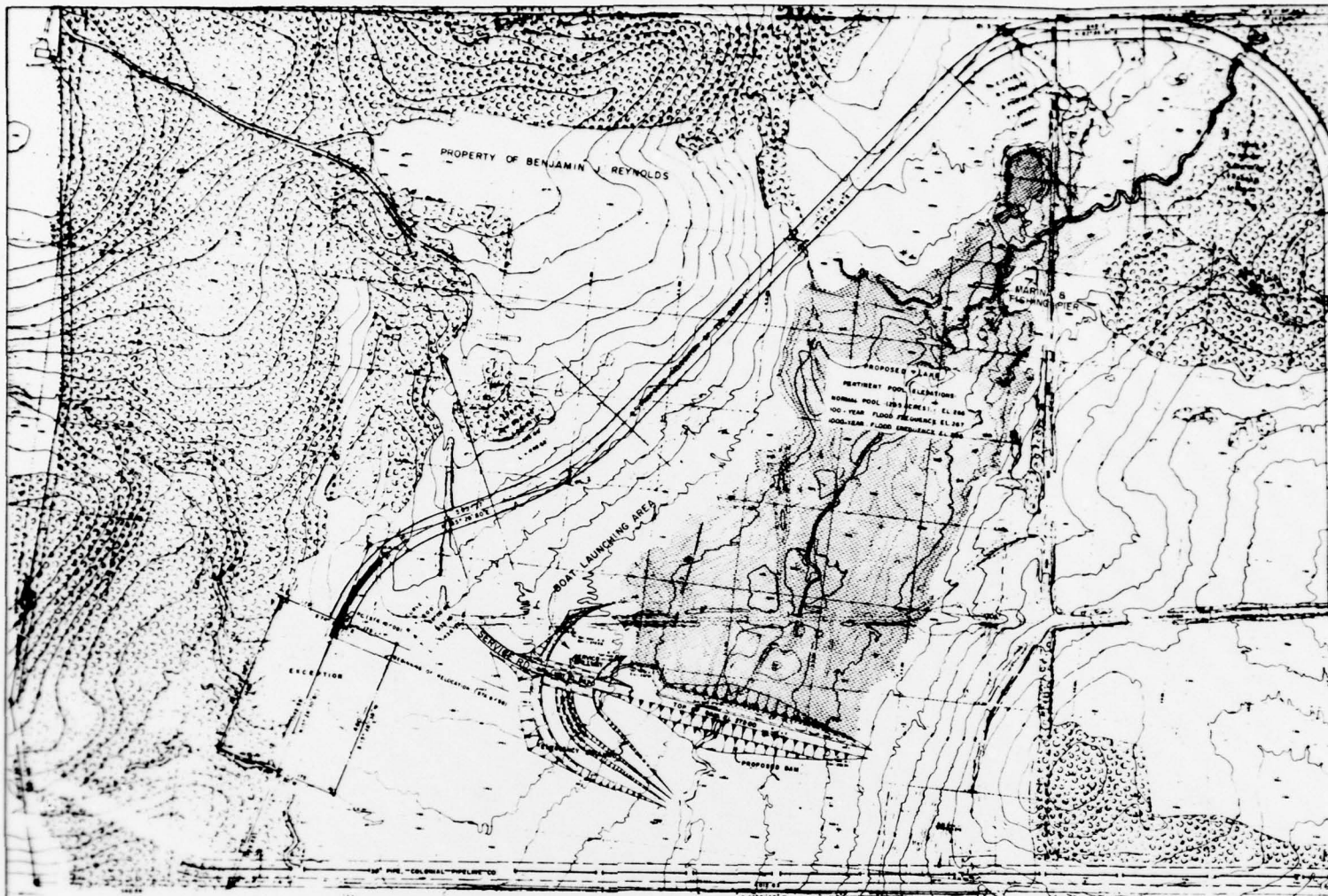


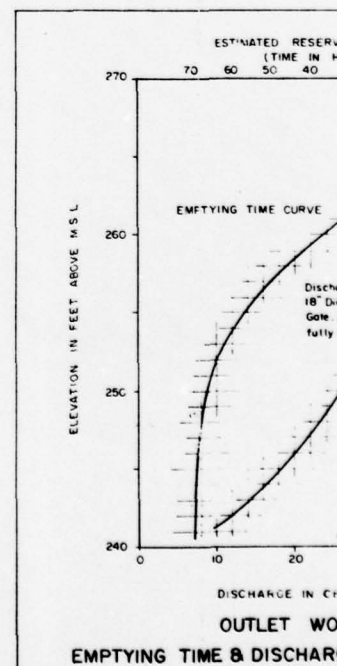
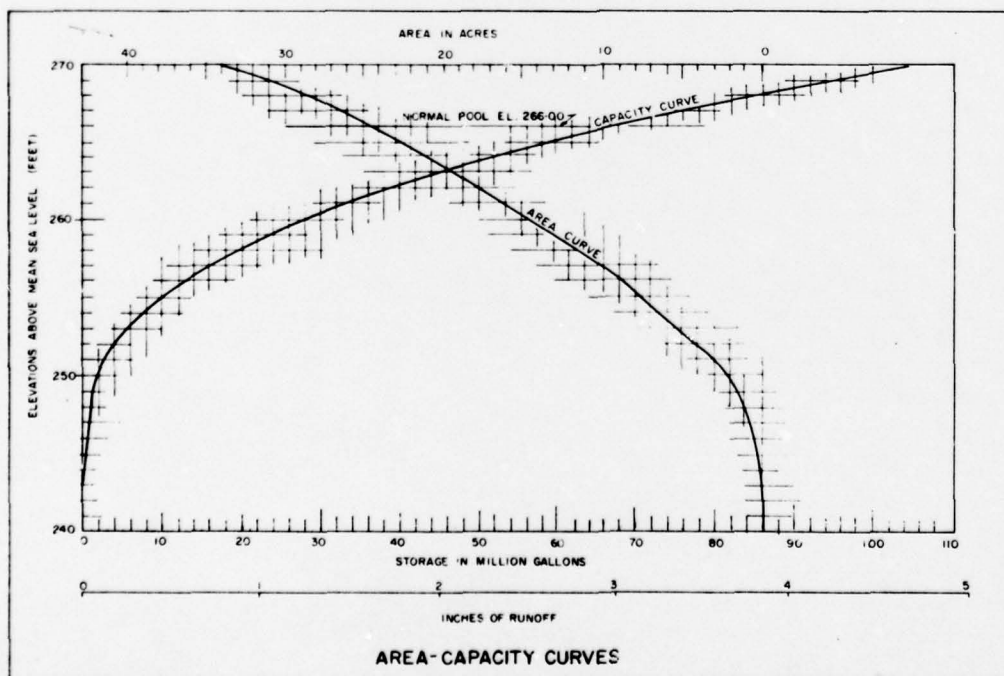
PLATE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

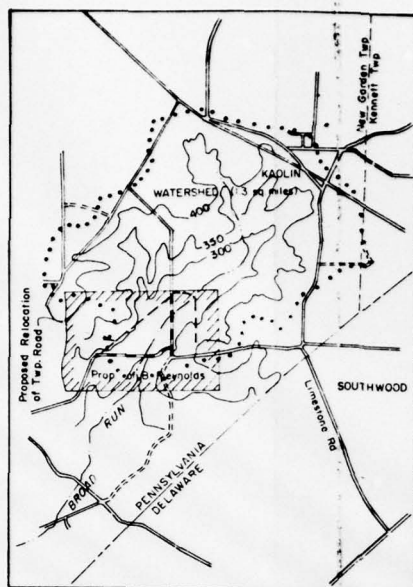
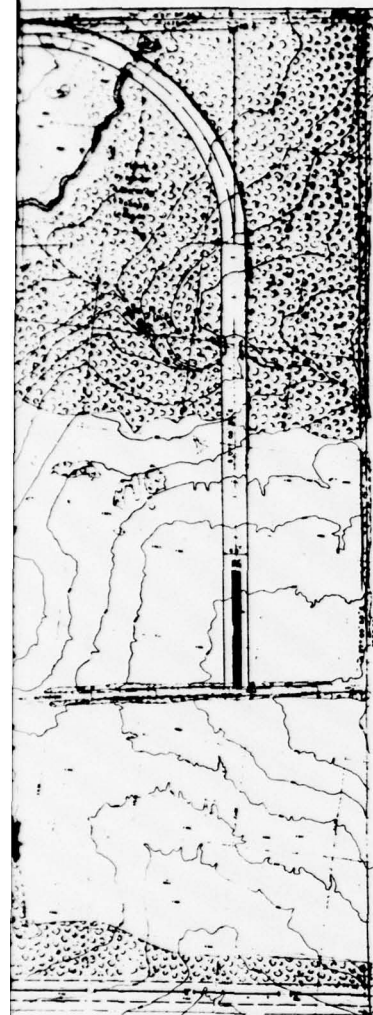




PLAN OF RESERVOIR AREA

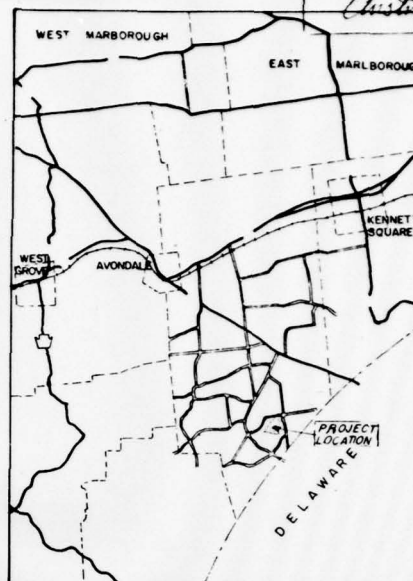
Scale - 1" = 200'





SITE MAP

1000' 0 1000' 2000' 3000' 4000'
SCALE

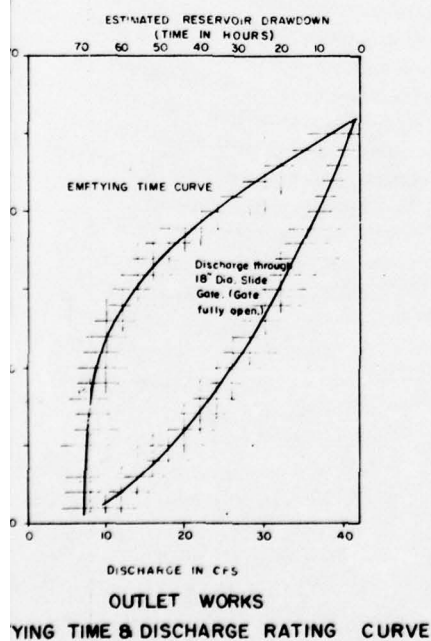


LOCATION MAP

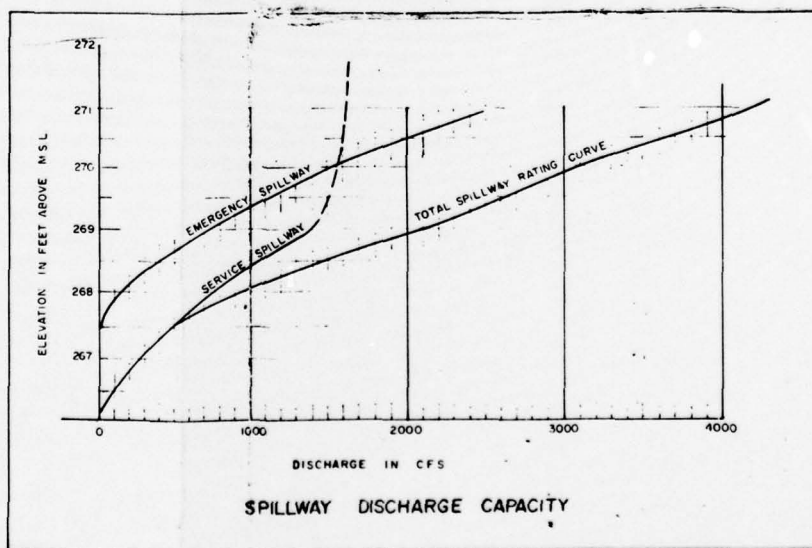
1 1/2 0 1M 2M 3M
SCALE

JUL 26 1966

G. H. McConnell
G. H. McConnell
Chief Engineer



OUTLET WORKS

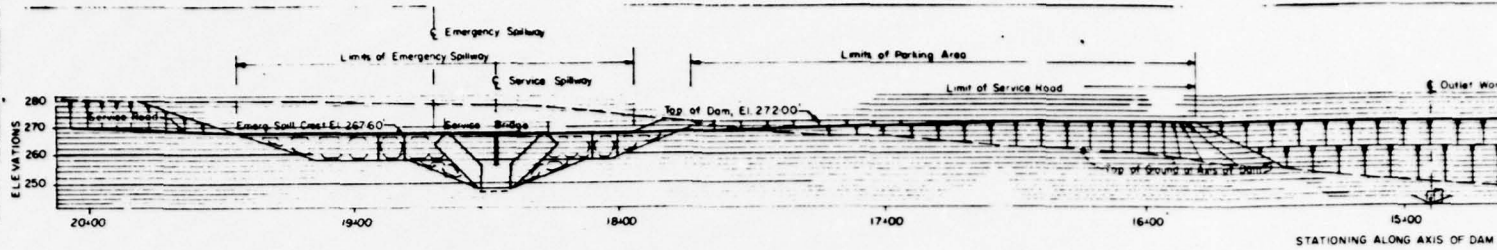


SPILLWAY DISCHARGE CAPACITY

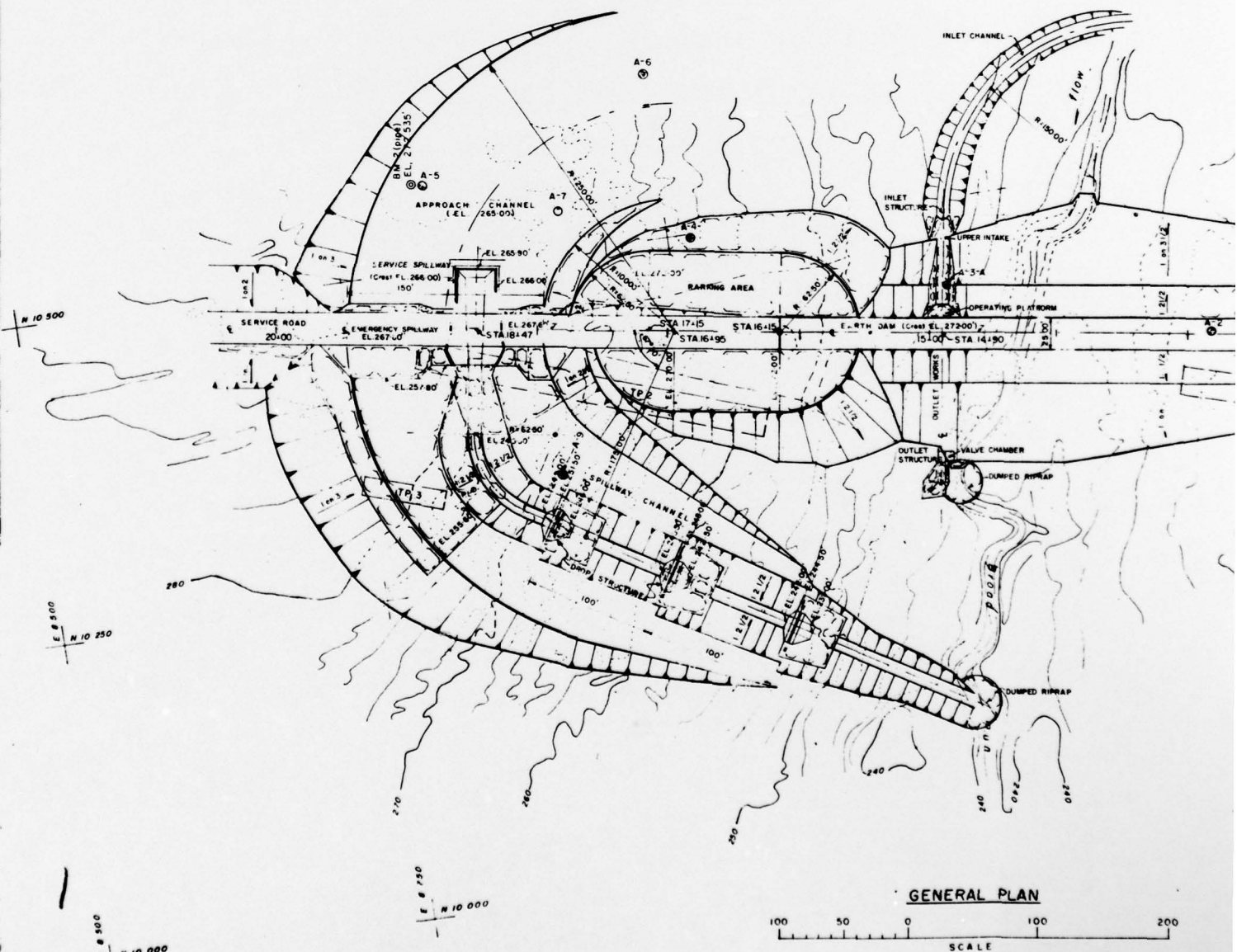


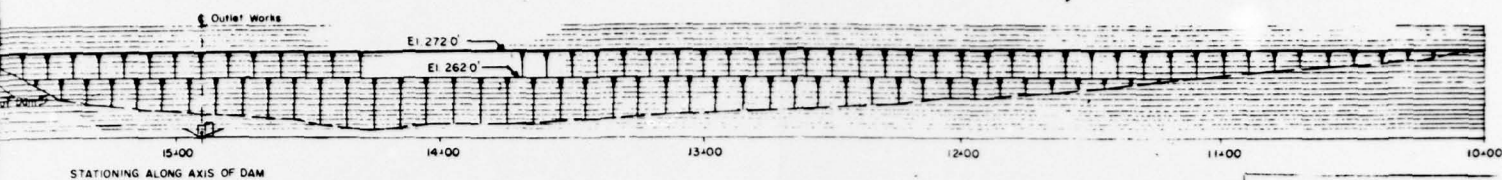
PLATE 2

SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP. CHESTER CO., PA.	
DRAWN GY TRACED PHS CHECKED GY APPROVED <i>Gideon Yachin</i>	LOCATION & SITE MAPS PLAN OF RESERVOIR AREA AREA CAPACITY & RATING CURVES
DATE JULY, 1966	GEO- Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.
SHEET NO. 1	



ELEVATION
(LOOKING UPSTREAM)



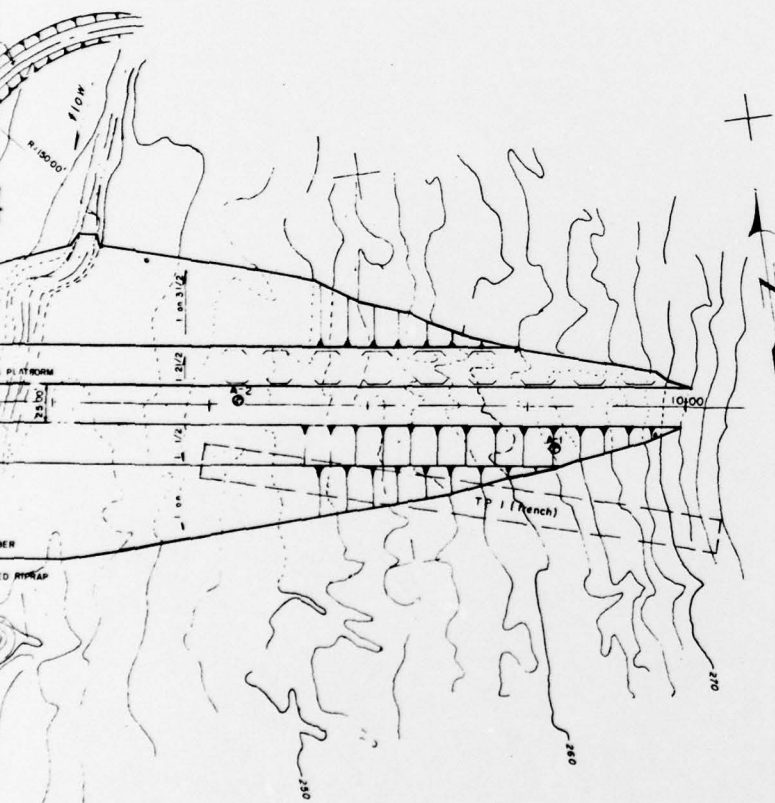


ELEVATION
(LOOKING UPSTREAM)

15-295-3
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THE 3 DAY OF July A.D. 1966
J. H. McCaskey
Chief Engineer

RECORD _____ FOR _____
SEE REPORT NO. _____
Div. Dams

JUL 26 1966
C. H. McCaskey
Chief Engineer



- LEGEND**
- A-2 TEST HOLE NO. 2
 - TP 3 TEST PIT NO. 3
 - [Hatched Box] EARTHEN SLOPE
 - [Dashed Box] DUMPED RIPRAP

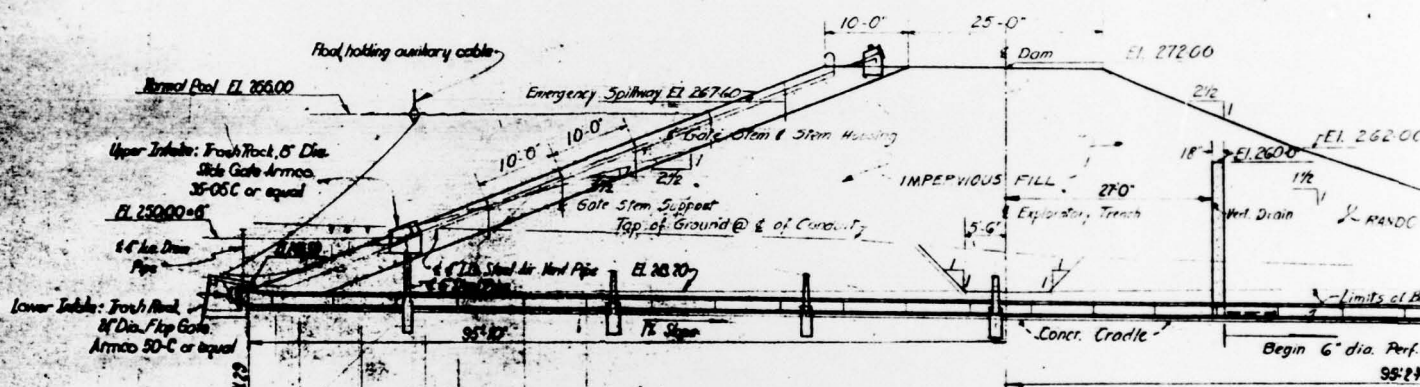
- GENERAL NOTES:**
- Topographic survey prepared by Keystone Mapping Co., Inc. of York, Pa. and G.D. Houtman & Son, Chester Co., Pa.; March, 1959
 - For logs of Test Holes, Test Pits, Geologic Section and Soil Characteristics, see "Soil and Foundations Conditions at the Dam-site," in the attached Specifications.

PLATE 3

SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP, CHESTER CO., PA.		
DRAWN GY	GENERAL PLAN & ELEVATION	
TRACED		
CHECKED GY		
APPROVED C. H. McCaskey		
DATE JULY, 1966	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.	SHEET NO. 2



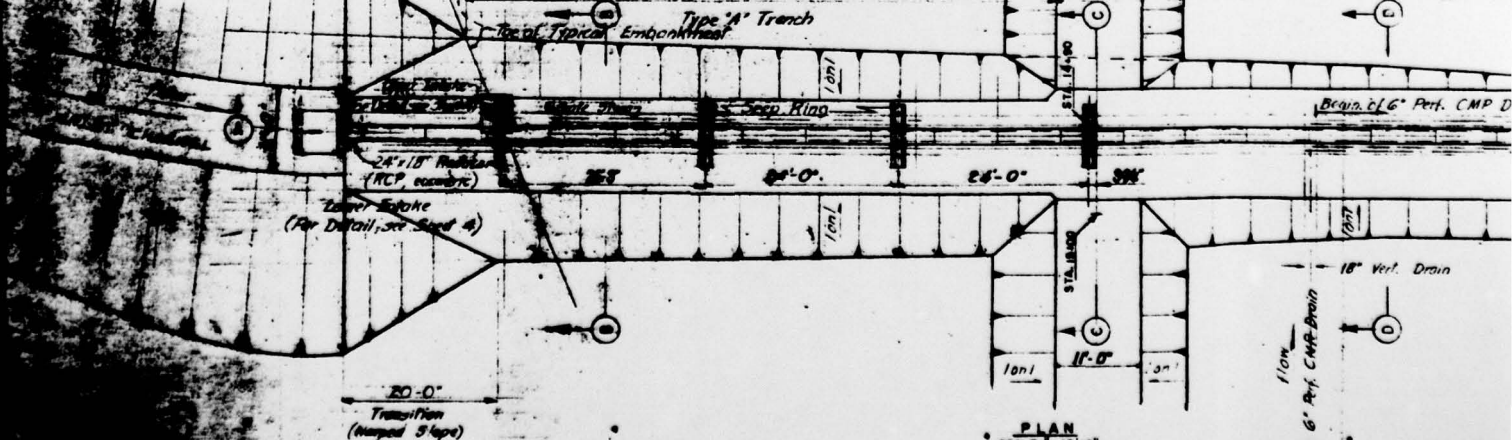
2



SECTION A-A

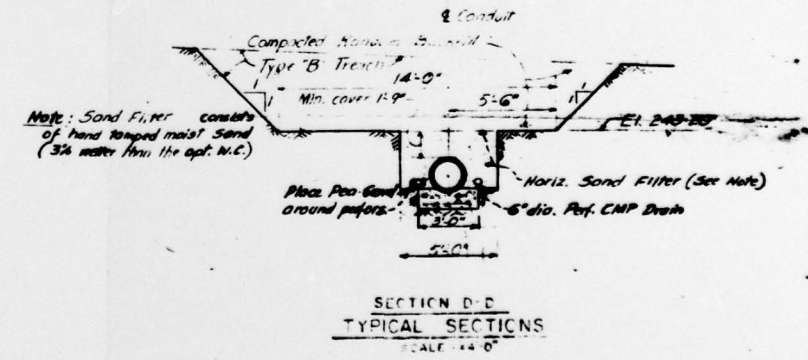
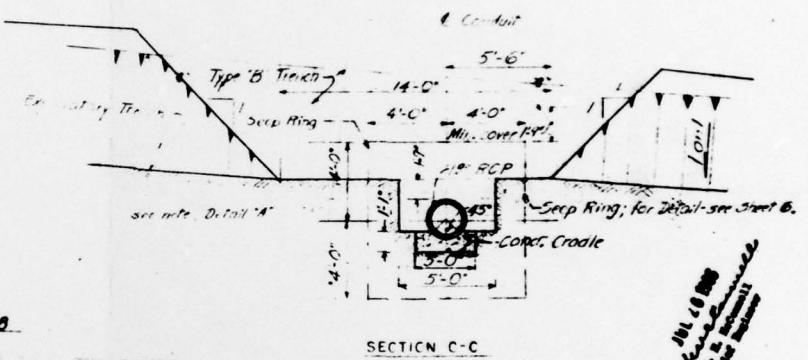
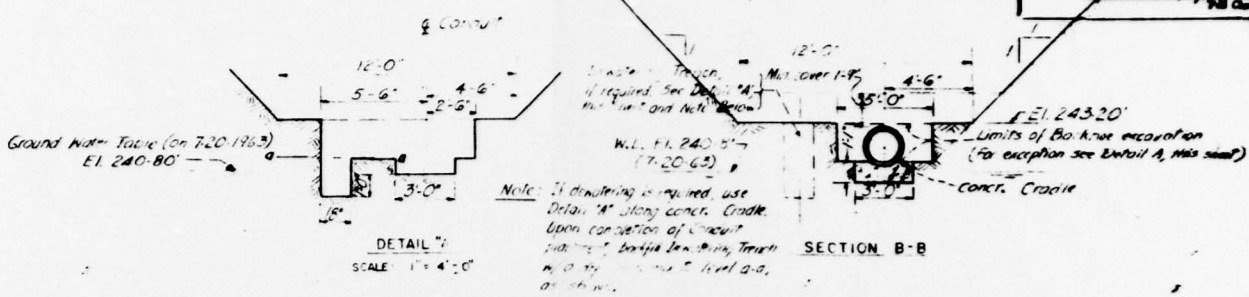
SCALE: 1"=10'-0"

- (1) The size of the Conduit is governed by the requirement to Draw Gate the Reservoir within 72 hours (See Rating Curves & Emptying Time, Sheet 1)
- (2) With the exception of (1) above, withdrawal and releases from the Reservoir would be done through the Upper Intake, equipped with an 8'-dia. Slide Gate, The 24'-dia. Flap Gate, located in the Lower Intake, would be necessary.
- (3) Under prevailing conditions, described in (1) above, the 24'-dia. Flap Gate should be opened. The procedure to open the Flap Gate is as follows:
- a. Water Level in Reservoir, above elevation of Upper Intake:
 - a-1. Close downstream 18'-dia Slide Gate
 - a-2. Open 8'-dia. Upstream Slide Gate to equalize pressure on both sides of Flap Gate
 - a-3. Pull chain on operating Platform to open Flap Gate.
 - b. Water Level in Reservoir, below elevation of Upper Intake - Either:
 - b-1. Use Floating Raft (not shown on these Drawings), equipped with "dead weight", to pull auxiliary Cable, attached to Flap, as shown on Sheet 4; or
 - b-2. Unplug vert. 4'-dia. pipe (Sheet 4), equalize pressure on both sides of Flap Gate and pull Chain as described in a-3. above.



PLAN

REC'D	FOR	15-295-4
SEE REPLY TO	Dr. Camp	FILE NUMBER
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FOREST & WILDERNESS, U.S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D.C.		



- GENERAL NOTES**
1. Trench excavation to be made as shown in section to fit the structure indicated.
 2. Upon completion of Conduit placement and prior to backfilling around the joints, the conduit shall be tested under full operating pressure. For test procedures, see accompanying Specifications.
 3. Backfill, other than rock, shall consist of compacted materials, as shown on this sheet. The compaction methods shall be required:
 - a. Hand tamping, along and around the Conduit and Sump Rings.
 - b. Compaction by roller above the min. cover over the Conduit in Type 'B' Trench (see Section D-D) and above the min. cover over Sump Rings (see Section C-C) in Type 'A' Trench.

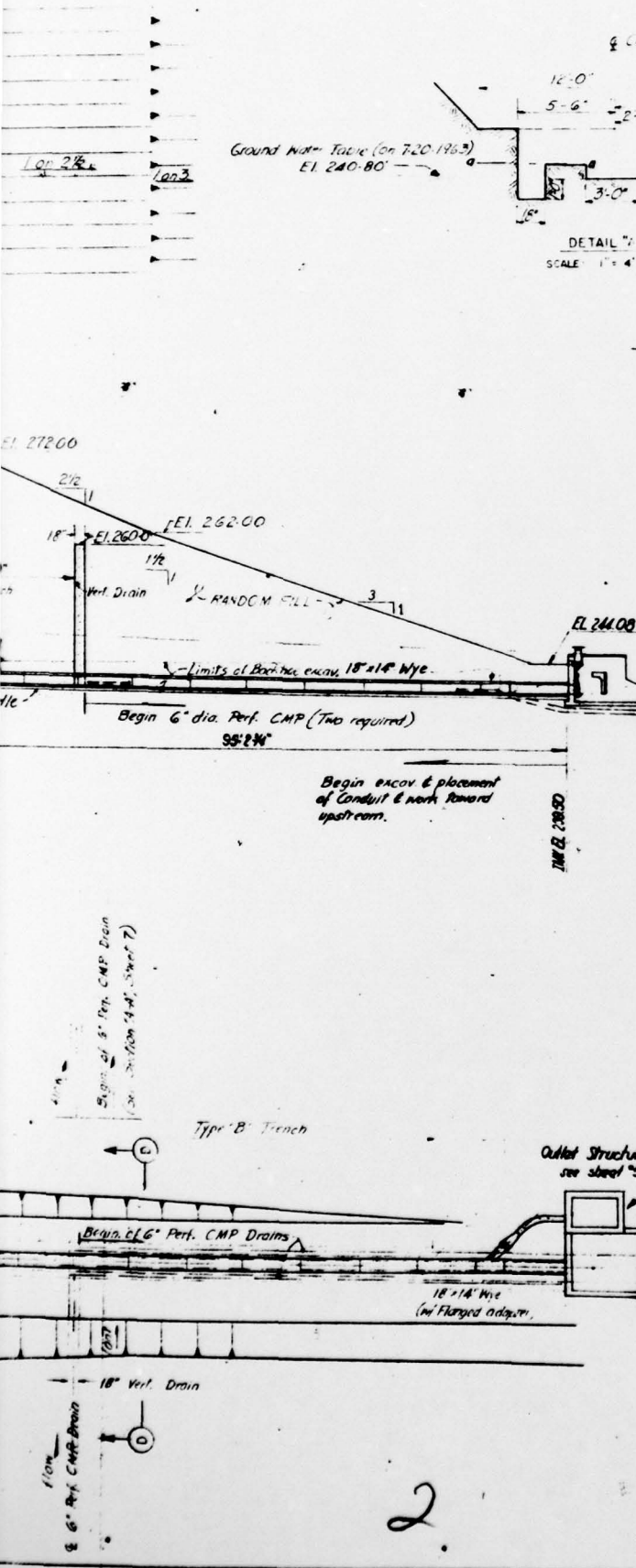
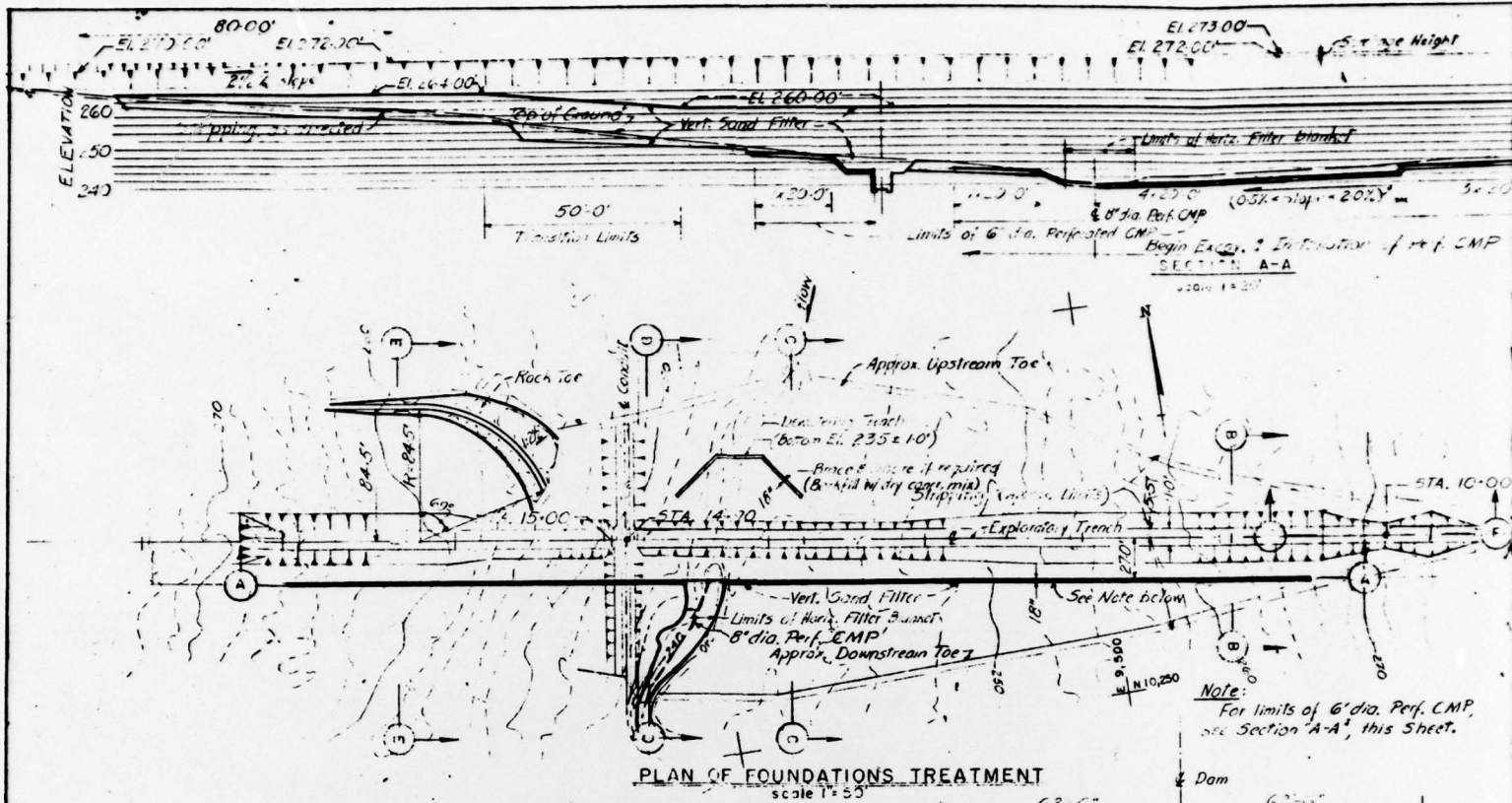


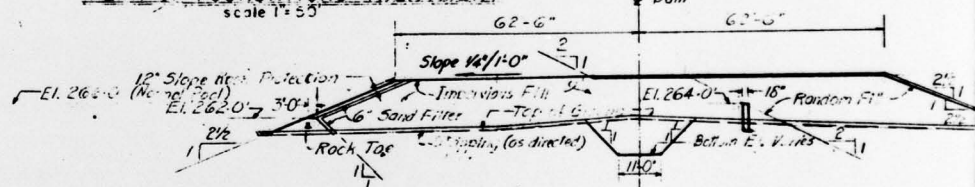
PLATE 4

SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP. CHESTER CO. PA.	
DRAWN BY	TRACED
CHECKED BY	APPROVED
DATE	JULY, 1966
OUTLET WORKS PLAN, SECTIONS & DETAILS	
GEO-Technical Services CONSULTING ENGINEERS & GEOLGISTS HARRISBURG, PA.	



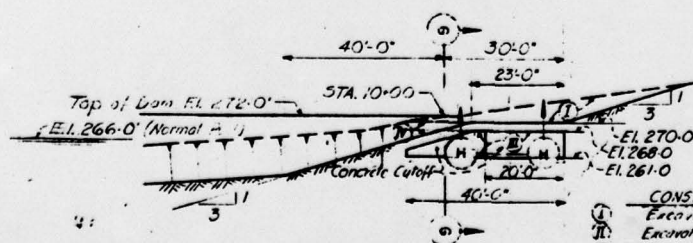
PLAN OF FOUNDATIONS TREATMENT

scale 1" = 50'



SECTION E-E

scale 1" = 20'



SECTION F-F

scale 1" = 20'

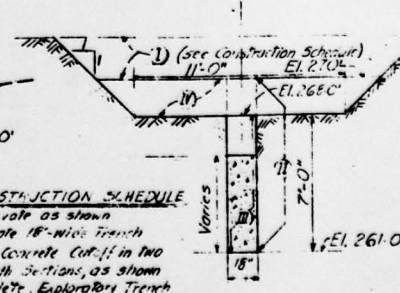


SECTION H-H

scale 1" = 4'-0"

CONSTRUCTION SCHEDULE

- 1. Excavate as shown
- 2. Excavate 18"-wide trench
- 3. Place Concrete Cutoff in two month sections, as shown
- 4. Complete Exploratory Trench excavation, as shown

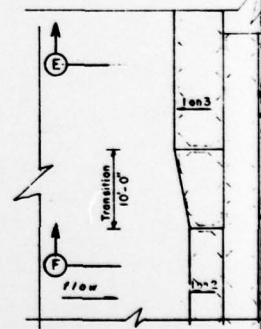
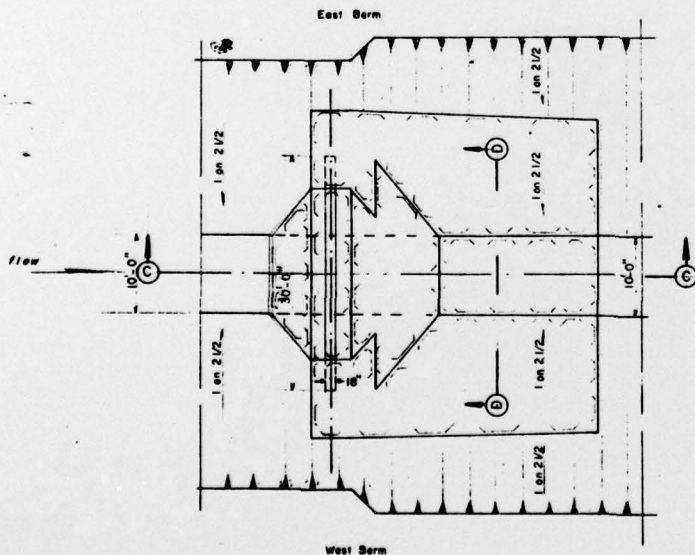
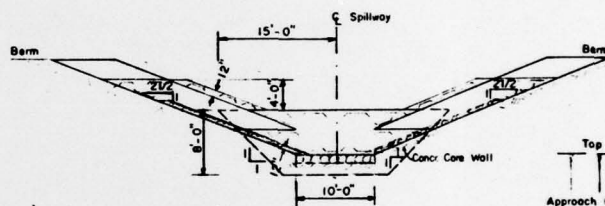
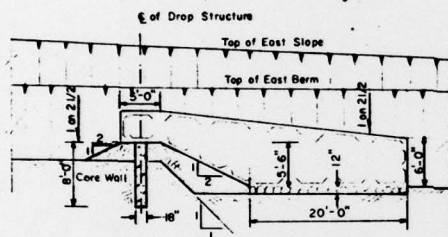
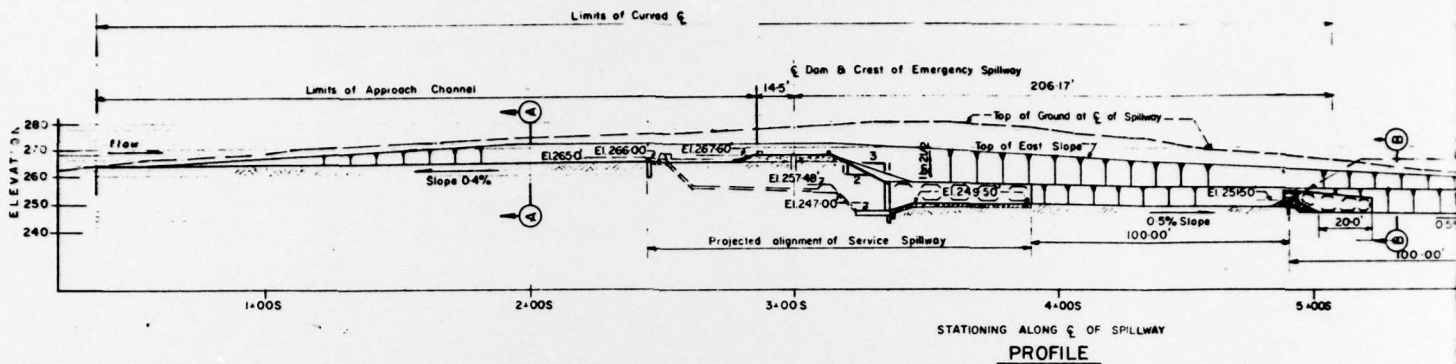


SECTION G-G

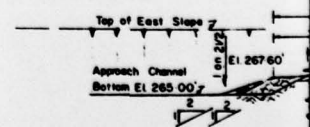
scale 1" = 4'-0"

Horizontal distance between indicated limits

Note: For 18\"/>



TYPICAL "DROP-STRUCTURE" DETAIL
SCALE: 1" = 10'-0"

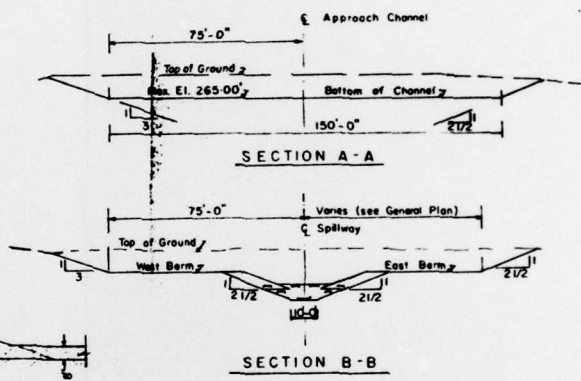
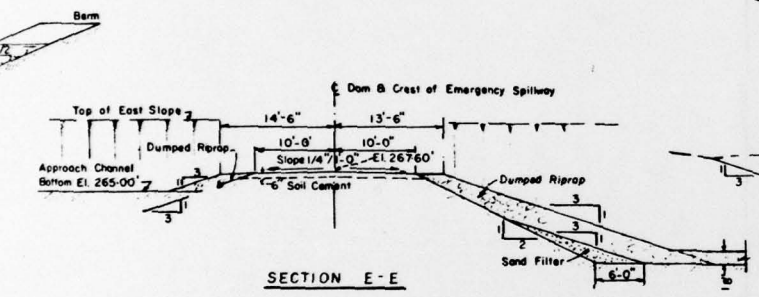
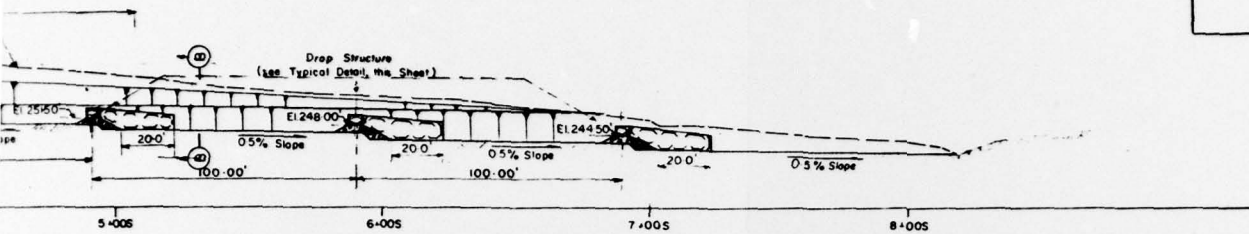


TYPICAL

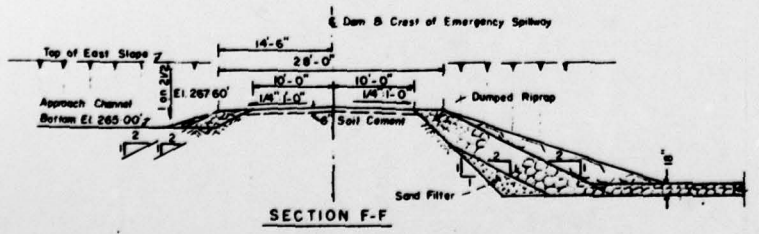
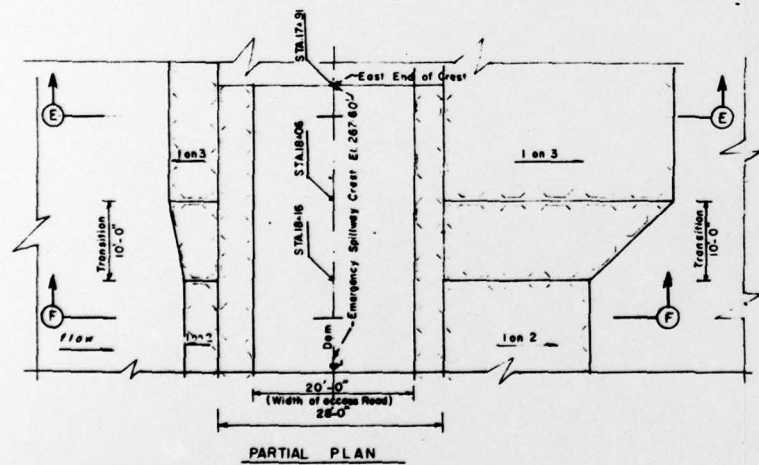
15-295-9
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 RESOURCES DIVISION DEPARTMENT OF FOREST & WATER
 WATERS ON THE 13th of July A.D. 1966
 C. H. McConall
 Chief Engineer

RECD FOR
 SEE REPORT NO.
 Date

JUL 28 1966
 C. H. McConall
 Chief Engineer



TYPICAL SPILLWAY SECTIONS
 SCALE: 1" = 30'

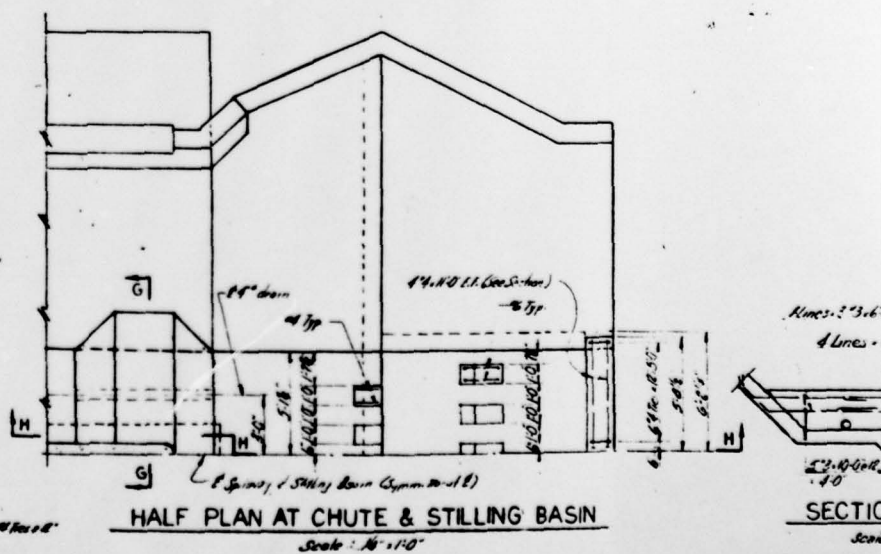
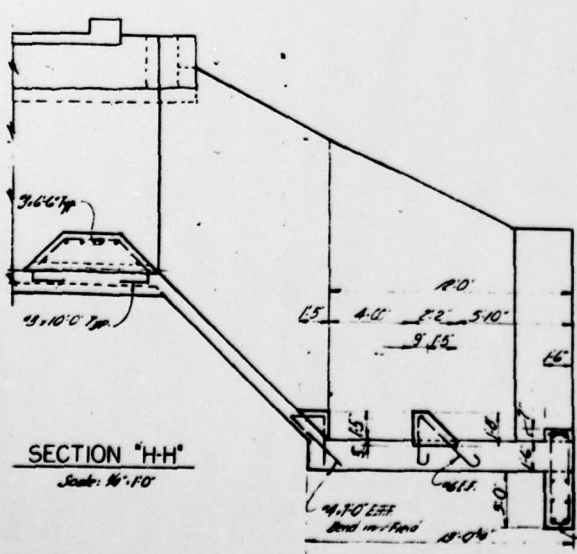
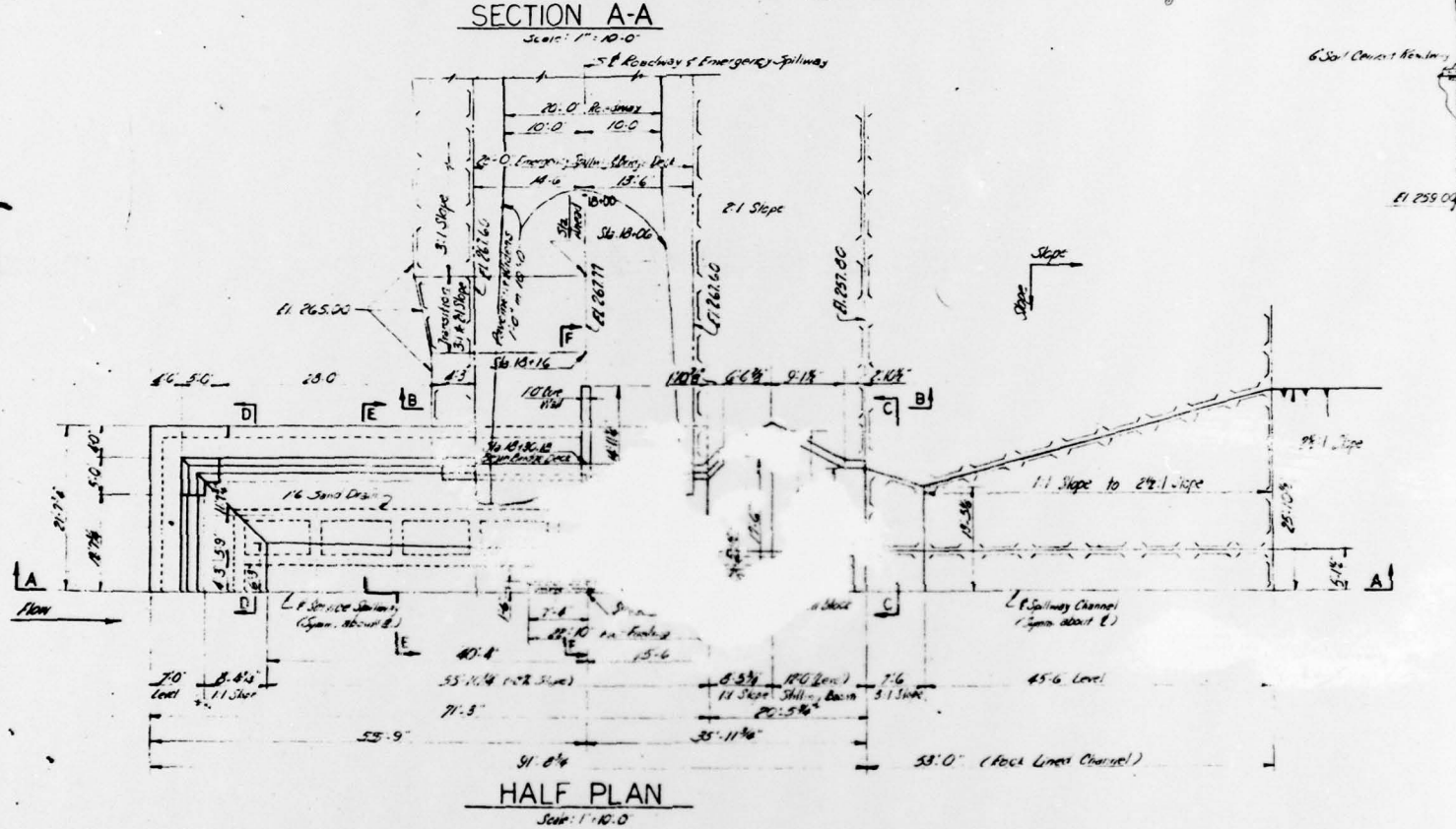
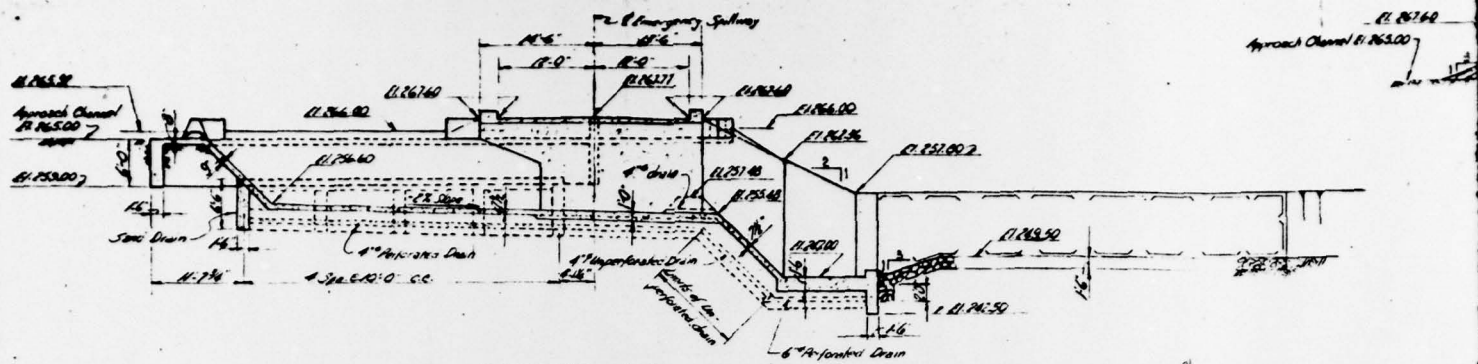


TYPICAL CREST DETAIL
 SCALE: 1" = 10'-0"

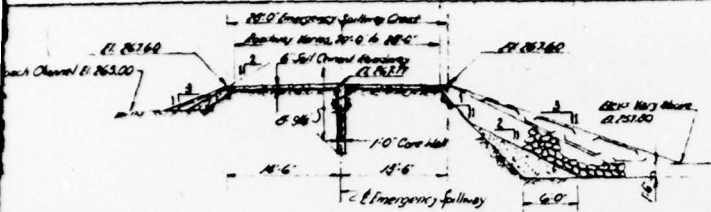
PLATE 6



SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP, CHESTER CO., PA.			
DRAWN BY	EMERGENCY SPILLWAY		
TRACED			
CHECKED BY	PROFILE, SECTIONS & DETAILS		
APPROVED			
DATE JULY, 1966	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.	SHEET NO. 8	

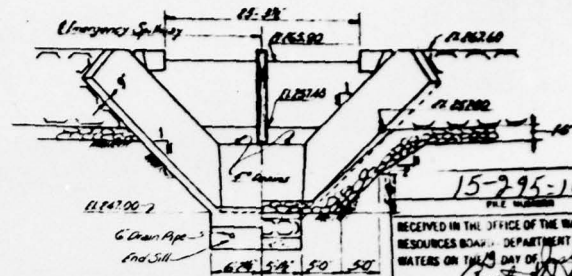


SECTION
Scale: 1/4" = 1'-0"



SECTION "B-B"

Scale 1" = 10'-0"

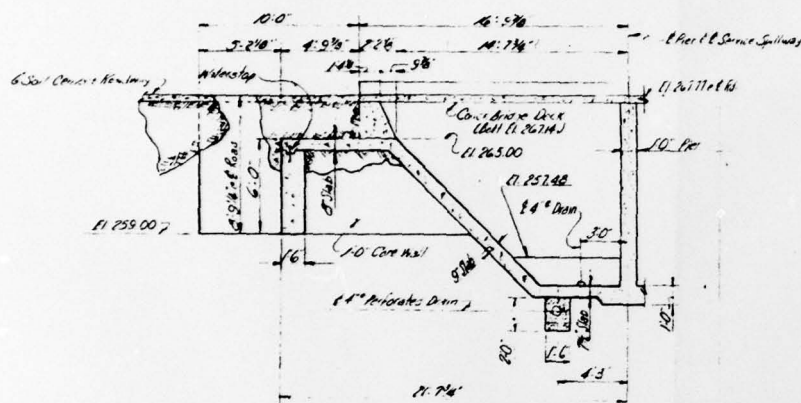


SECTION "C-C"

Scale 1" = 10'-0"

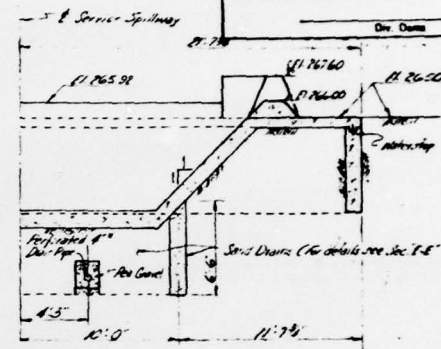
15-295-10
RECEIVED IN THE OFFICE OF THE WATER & P.W. RESOURCES BOARD, DEPARTMENT OF E.P. & WATERS ON THIS DAY OF JULY 1946
C. H. Reynolds
Chief Engineer

RECD. FOR
SEE REPORT NO.
Div. Comm.



SECTION "F-F"

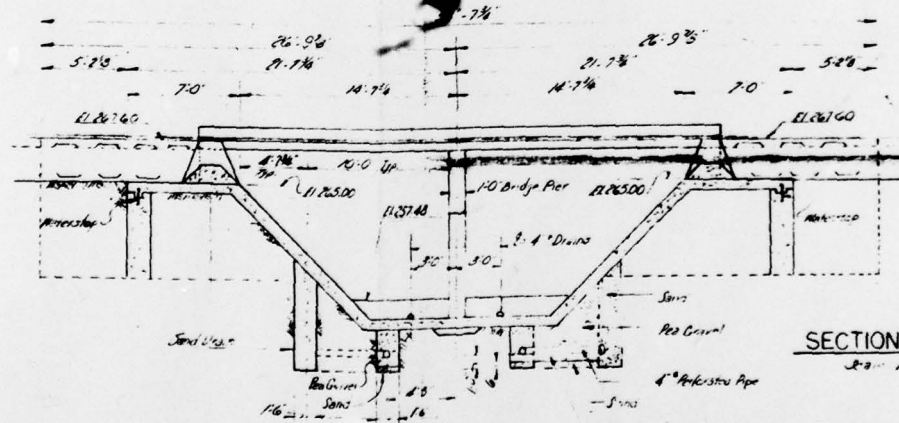
Scale 1" = 5'-0"



SECTION "D-D"

Scale 1" = 5'-0"

JUL 28 1946
C. H. Reynolds
Chief Engineer

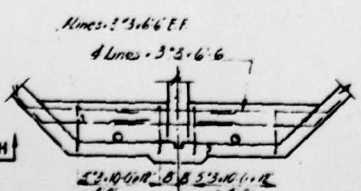


SECTION "E-E"

Scale 1" = 5'-0"

GENERAL NOTES

- Start excavation of Service Spillway after completion of Emergency Spillway, crest elev. 267.60 as approx. shown EL 265.00.
- Particular care shall be exercised to prevent overcut in the Service Spillway excavations.
- Excavate trenches for concrete cut-off and filter as shown prior to the completion of the excavation to bottom of filter slab.
- Provide rubble or plastic waterstop as shown.
- For reinforcement details see sheet No. 10.
- For class of concrete, required strength and type of mixes, see accompanying specifications.



SECTION "G-G"

Scale 1" = 10'-0"



PLATE 1

SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP., CHESTER CO., PA.			
DRAWN JRH	SERVICE SPILLWAY PLAN, SECTIONS & DETAILS		
TRACED JRH			
CHECKED			
APPROVED C. H. Reynolds	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.		SHEET NO. 9
DATE JULY, 1966			

SUBJECT	SHEET	BY	DATE	JOB NO.
SHANGRI-LA DAM				

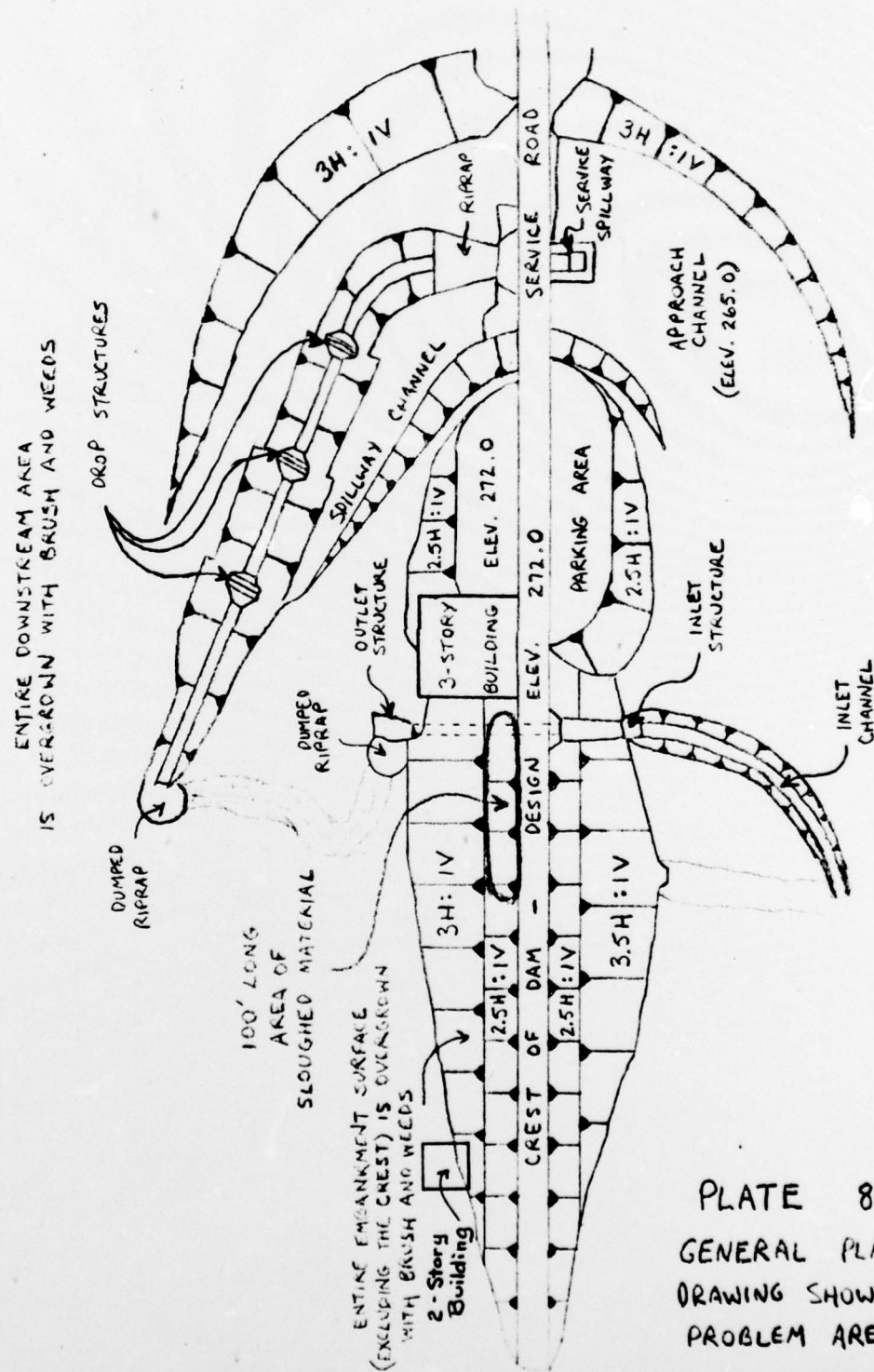


PLATE 8
GENERAL PLAN
DRAWING SHOWING
PROBLEM AREAS

SUBJECT	SHEET	BY	DATE	JOB NO
SHANGRI LA DAM	9	RRB	6/79	

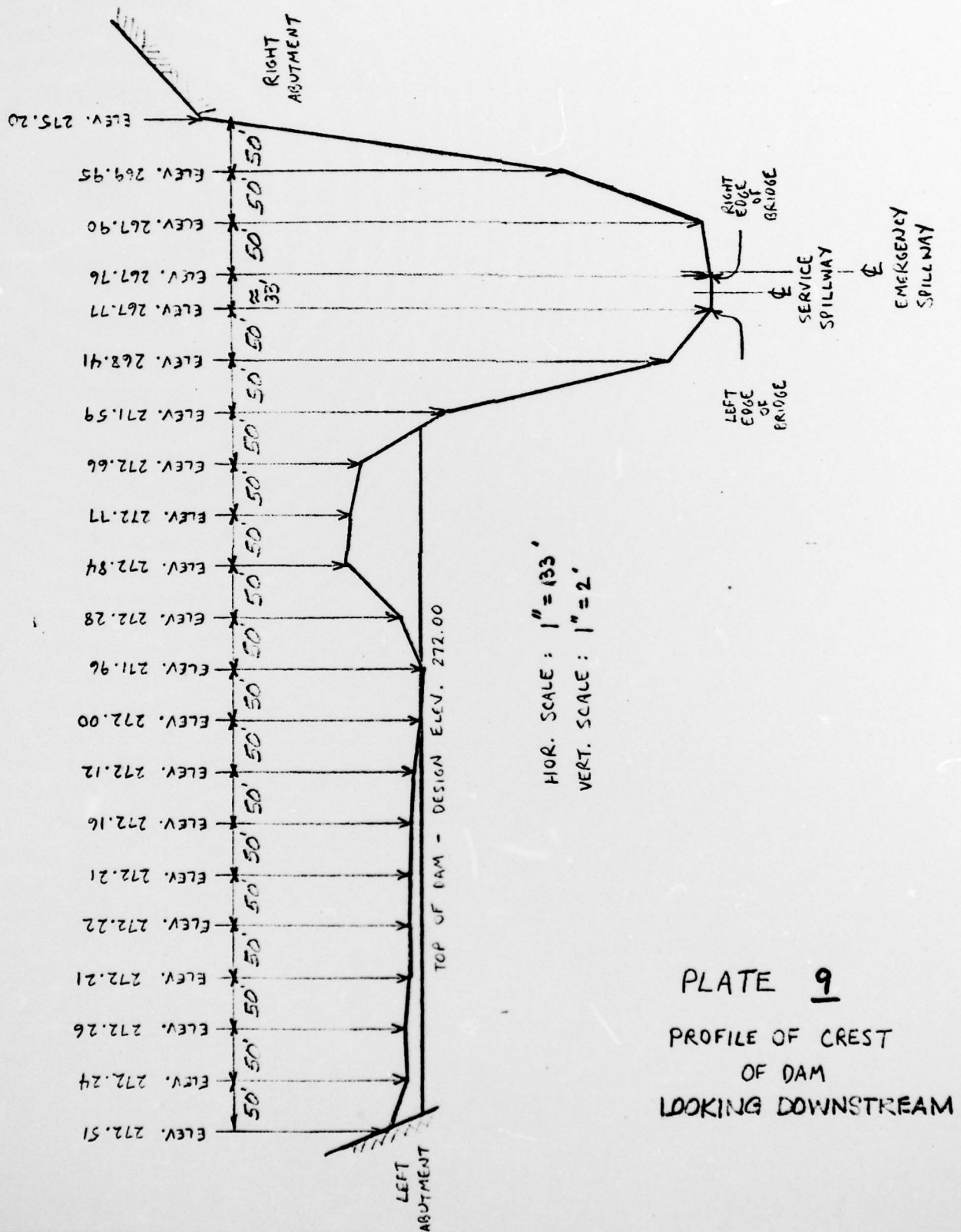


PLATE 9
PROFILE OF CREST
OF DAM
LOOKING DOWNSTREAM

APPENDIX

F

Site Geology

SITE GEOLOGY

SHANGRI-LA DAM

The Shangri-La impoundment is located in the Upland section of the Piedmont physiographic province. Bedrock at the dam site is composed of complex metamorphics dating from the Precambrian to the Lower Paleozoic eras. It is probable that the rock units present at the site are a hornblende gneiss with pegmatitic dykes and oligoclase mica schists of the Wissahickon formation. No faults or major structural defects are noted in the vicinity of the dam or reservoir.

